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ORIGINAL MEMOIRS.

LUDWIG'S ANGINA.

AN ANATOMICAL, CLINICAL AND STATISTICAL STUDY.*

BY T. TURNER THOMAS, M.D.,

OF PHILADELPHIA,

Instructor in Surgery in the University of Pennsylvania; Assistant Surgeon to the University and the Philadelphia General Hospitals.

LUDWIG in 1836, described a condition which he considered a morbid entity, and which since that time has been designated, more or less universally, as Angina Ludovici. Various attempts have been made to establish it upon a definite pathological basis, but the results of none of these can be said to have been generally accepted. That it is an infection there can be no doubt, but the character of the infection if it has a special character, has never been decided. That it is more rapidly fatal than similar infections occurring in other parts of the neck than the submaxillary region, is amply proved by the recorded cases, but why or how it acquires so dangerous a character, has never been clearly demonstrated. It is well known that certain cases assume a grave aspect and threaten or take the life of the patient in twelve to twenty-four hours, while others begin and continue as a comparatively mild affection for days and then suddenly assume an alarming character. That its general course and symp-

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toms are typical and essentially constant is convincingly shown by the numerous cases that have been reported. Yet many have been and some are still being reported, which should not be designated by this term. The following case led the writer to make a study of the subject.

W. W., male, age 32 years, machinist, admitted to drunk ward of the Philadelphia Hospital, August 10, 1903. On admission the temperature was 98, pulse 110, respiration 30. Has been drinking for about a month. Is nervous and has marked tremors of the hands and tongue. He cannot eat or sleep. The heart is rapid but the sounds are good, and there are no murmurs. He has no hallucinations, and is well nourished. He complains of a small, painful swelling under the right side of the lower jaw which has been there for about a week. On August 13 he was transferred to the surgical ward, in the service of Dr. A. C. Wood, to whom the writer is indebted for the privilege of reporting the case. Temperature 98.2, pulse 78, respiration 22. The swelling is increasing in size. The pain keeps him awake at night and prevents him from taking his nourishment. Incision made in the submaxillary region, the index finger being introduced its entire length without evacuating any pus. August 14th swelling is increasing rapidly, is hard, non-fluctuating, and involves the whole under side of the jaw. Speech is difficult, and he is having such difficulty in swallowing that he is being fed with a spoon. Temperature 101, pulse 100, respiration 26. General condition otherwise good. August 15, at 8 P.M., he was cyanotic and respiration was very difficult. Tongue swollen. Oxygen inhalations given for a time with some relief. Then he became rapidly worse. Pulse intermittent, rapid and weak. At 10 P.M. tracheotomy was performed by the resident in charge, Dr. Speese. Incision below the cricoid cartilage. Profuse bleeding from the veins in front of the trachea. Surrounding tissues very œdematous. From the time the trachea was opened the patient's condition rapidly became worse, and although he breathed through the tube, he could not be kept alive by artificial respiration, which was continued for about fifteen or twenty minutes.

Autopsy—Pathological Diagnosis.—Œdema of the glottis; unilateral interstitial nephritis; hemorrhagic infiltration of intestinal mucosa. The tissues about the glottis and epiglottis are

intensely swollen. This swelling is so extensive about the glottis that only a chink, about 2 mm. in breadth and 6 mm. in length of the glottis remains.

The writer regards this case as a typical Ludwig's Angina. The following case was reported, September 4, 1905, before the North West Medical Society of Philadelphia, as a "Gun Shot Wound of the Lower Jaw, followed by Submaxillary Cellulitis, simulating Ludwig's Angina." Since then a study of the literature has shown other cases, reported as Ludwig's Anginas, which were essentially of the same type. The writer considers that this grade of infection in this region has every dangerous characteristic, indeed somewhat exaggerated, of a typical Ludwig's Angina. The reader is referred to the later discussion on etiology and pathology, for the writer's reasons for including it here as an example of this disease.

J. W., colored, age 31 years, admitted to the Philadelphia Hospital, August 9, 1905, in the service of Dr. A. C. Wood, with whose permission the writer reports the case. His general health and strength were excellent.

On August 8th, in a quarrel, the patient was shot twice by a revolver in the hands of a companion, who stood in front of him, and about five or six feet away.

There are three wounds of the face, one of which is a well-rounded and perforating wound of the cheek, about three-eighths inch in diameter, just to the right of the symphysis. A second wound with irregular edges is situated on the right cheek, about one inch in front of the lobule of the ear. A fragment of a bullet was removed from this wound. The third perforation, which was so insignificant and covered by stubby beard that it was not discovered for a few days, is shaped like the first, and is situated on the left cheek about two and a half inches posterior to the angle of the mouth. The probe enters this wound for about two inches, when it strikes what at first was thought to be the ramus of the jaw. A skiagraph later showed a bullet lodged in the tissues in about the situation of this opening. At first the patient did not complain of this wound, and it was then thought that

the two on the right side were produced by the two bullets. It seems evident now that they were due to a single bullet which entered near the symphysis, struck the jaw, splintered it, and was divided, one fragment glancing off and producing the wound in the right cheek near the lobule of the ear. Both wounds of the right cheek met within the mouth at the injured portion of the jaw.

The tissues of the interior of the mouth, internal and external to the jaw, are intensely swollen, particularly internal to the jaw in the floor of the mouth. The tongue almost fills the mouth and interferes with normal respiration. Speech and deglutition are disturbed. There are four teeth missing in the lower jaw in the right molar region. The patient says the teeth were not missing before the shooting. In the space corresponding to the missing teeth the alveolar border of the lower jaw is splintered, the loose fragments being removed with forceps. There is a complete fracture of the lower jaw on the right side about an inch anterior to the ascending ramus. The wounds were all washed out and packed with gauze, dressings applied, and a cardboard cup was fitted to the jaw and held by a Barton's bandage.

On the following day the patient's condition became alarming on account of the difficulty in breathing. The face was more swollen, particularly in the submaxillary region. The tongue and the floor of the mouth were more swollen than on the preceding day, and the tissues in the floor of the mouth were more brawny to the feel. The patient was etherized and the two wounds on the right side of the face were enlarged into the mouth. All loose fragments of bone and soft tissue were removed and the wounded tissues irrigated with boric solution. An incision about two and a half inches long was made parallel with the lower jaw and about midway between the hyoid bone and jaw. This wound was deepened until the finger was close to the mucous membrane of the floor of the mouth in the region of the damaged portion of the lower jaw. Irrigation and dressing as before. Temperature 101.3°, pulse 128.

On the following day, August 11th, his condition had improved slightly, but the swelling and temperature were about the same. Respiration, deglutition and speech were still disturbed. On examining the region of the injury to the jaw, the wound in the floor of the mouth was found covered with gan-

grenous sloughing tissue, and the odor was very foul. The wounds in the lip and cheek leading away from this region were discharging foul pus. A mouth gag was introduced on the opposite side of the mouth and the tongue held away from the infected area, thus exposing it. After clearing away all shreds of gangrenous tissue and irrigating with boric solution, the infected surface was cauterized with pure carbolic acid, which was neutralized at once by applications of alcohol. The patient was placed in charge of a special nurse, who cleansed the infected region every half hour with peroxide of hydrogen and boric solution.

On the following day a marked improvement was noticeable. The swelling was evidently decreasing, the patient could talk, swallow and breathe better, and said that he felt much better. In the few succeeding days the temperature fell to normal. The discharge was still copious and offensive. The septic condition soon subsided and the case resolved itself into one of healing wounds of the face and neck and fracture of the lower jaw, which later united.

History.—Parker, in 1879, published an interesting historical review of this condition as recorded before the appearance of Ludwig's paper, with particular reference to the cases occurring in England. He gives some details of a case referred to by Auretius which seem to have been those of a Ludwig's Angina. He called the condition, "cynanche." Paulus Aegineta spoke of a somewhat similar condition, which he called "paracynanche." Many of the older authors, both Greek and Arab, including Hippocrates, Galen, Celsus, Aurelianus, Rhases and others, had described the disease. Dr. Fothergill gave an account of "Putrid Sore Throat" (1739–1746), which appeared to have some of the characteristics of Ludwig's Angina. He also gave an historical review of what is believed to have been the same disease. Dr. Kirkland in 1786, Dr. Wells in 1809, and others reported cases of this type.

It remained, however, for Ludwig to present the first accurate description of this dangerous condition, which he called "gangrenous induration of the neck." Cameror, in

the following year was the first to apply to it the name, Ludwig's Angina. Following the appearance of Ludwig's paper considerable interest was manifested and an increasing number of cases were reported. Probably, greater interest has never been shown during any one period, than that which was bestowed on it by the French Surgical Society, in 1892. Several successive meetings were devoted to it and many cases cited by those present. There was a marked difference of opinion manifested, which culminated in a division of the members into two parties, one being led by Nelaton, the other by Delorme. Nelaton took the stand that Ludwig's Angina should not be recognized as a separate disease, and was instrumental in having resolutions to this effect passed by the society. At the following meeting Delorme caused this action to be reconsidered and Ludwig's Angina to be given its proper place in surgical pathology. In the following year Leterrier published a thesis in which he reported 27 cases collected from the literature and communicated four new ones, three of Delorme's and one of his own. The chief object of his paper appeared to be to support the position of his teacher, Delorme, who contended that Ludwig's Angina was primarily a sublingual phlegmon.

In the same year, 1893, Poulsen published the results of a study of 530 abscesses of the neck collected from hospital statistics. In 1886, he had presented a paper in which he reported his observations on a series of lime injections under the deep fascia of the neck, to prove the existence of communicating channels of loose connective tissue between the various adjacent interfascial spaces. In his second paper he attempted to show that infections tended to follow these channels and to invade the various spaces, successively. His explanation of the progress of the infectious process in a Ludwig's Angina will be taken up later in the discussion of the etiology and pathology of this disease.

In 1895, Semon's paper appeared, in which he maintained that acute septic inflammations of the throat and Ludwig's Angina were pathologically identical, and should be

included together as one group of diseases, thus eliminating Ludwig's Angina as a separate disease. Since that time nothing new has been offered on this subject so far as the writer can learn.

Etiology and Pathology.—Although fairly authentic cases were recorded before, practically, nothing was presented in the literature to establish the cause and nature of this condition, until Ludwig's paper appeared. Since that time many cases have been reported and much has been written, which is of value in clearing up the obscurities surrounding Ludwig's Angina. Yet its etiology and pathology still remain obscure. In the writer's opinion, one of the basic causes of confusion lies in the obscurity associated with the cause of death, in connection with which, the chief question is as to whether it results from septic intoxication or from invasion of the air passages. Probably, both conditions are always present to some degree, in typical cases; but the relative importance of each has never been established. If septic intoxication is the essential cause of death, then the especially high mortality of this condition is to be explained by the presence of a rare and especially virulent infection. If invasion of the respiratory tract is the dangerous feature, peculiar to this condition, then the mortality is to be explained by extension of the phlegmonous inflammation to the larynx and in some cases to the lungs. Upon the solution of this question depends, in the writer's opinion, the explanation of the etiology and pathology of Ludwig's Angina.

Ludwig suggested that it was epidemic in its nature, that it was allied to erysipelas and that it was a true morbid entity. Every one of these suggestions has been supported and combatted vigorously by many different authorities and it may fairly be said that they remain unsettled up to the present time. Tissier, Roser, and Chabri, for example, agree with Ludwig, as to its being a morbid entity. On the other hand, Boehler, who collected and studied 35 cases, refused to accept this view and tended to suppress the name of Lud-

wig's Angina. v. Thadden gave to it the name of "submaxillary bubo," while Chantemesse considered it a true erysipelas of the larynx. Roser believed that the disease began in the submaxillary salivary gland. This theory has not been borne out by the post-mortem evidence which has been accumulated. It will not be profitable to discuss here more than a few of the theories which have been offered as to the etiology and pathology of this condition, and it is particularly, to the later authorities that the writer will confine his attention.

As already indicated the investigations have followed two distinct channels; the bacteriological, which attempt to prove that a particular type of infection and therefore a septic intoxication is responsible for the condition; and the anatomical, which try to show that the condition is due to the particular location of the infection and its peculiar opportunities for dangerous extension.

Influence of Septic Intoxication:—Definite and positive convictions on the relative importance of septic intoxication, can not be reached without difficulty. In studying this phase of the subject, first importance should be given to the bacteriological findings. A search of the literature has shown the following cases in which different bacteria were found and reported.

Delorme, staphylococcus in one case and streptococcus in another; Leterrier, undetermined bacillus in one; Macaigne and Vanverts, pneumococcus predominating, with streptococcus and staphylococcus in one; Lockwood, streptococcus, staphylococcus and bacillus of malignant oedema in one of his own cases and in another, streptococcus, cocci and diplococci. In Gibson's case he also found the streptococcus; Biedert and Robertson, streptococcus in one; Gasser, streptococcus and bacillus coli communis in one; Ross, streptococcus and staphylococcus in one; Davis, streptococcus alone in two cases, and streptococcus and staphylococcus in a third; Ombredanne and Keim, streptococcus and staphylococcus in one; Humphrey, pneumococcus alone in one; Duplay, staphy-

lococcus in one; Chantemesse and Widal, streptococcus in one; Magnal, streptococcus in one.

It will thus be seen that of the 18 cases, the streptococcus was found alone in 6 cases; the streptococcus associated with other organisms in 8; the staphylococcus alone in 2; the pneumococcus alone in one; and an undetermined bacillus in one.

The fact that stands out most prominently in this group of cases is that the streptococcus was present in almost all, either alone or associated with other bacteria. That it may be present in some cases in which the investigation has failed to show it, may be inferred from the fact that Lockwood, by different methods, found the streptococcus in Gibson's case, although Cameron reported that he could find "no specific microörganisms in the tissues." In all the writer's collection of cases, the inflammation of the connective tissues has appeared to be of a severe type, and in a considerable number a gangrenous or fetid process has been present. The inference to be drawn from these facts is that a severe septic infection and a corresponding grade of septic intoxication has been encountered. Yet in many cases the constitutional symptoms have been only moderate or very mild. Even if they were severe in all, this would not show that they were the cause of the high mortality, since the same infections occurring in other parts of the body, giving as severe local and constitutional symptoms, do not produce the same death rate as does Ludwig's Angina. Since the existence of a special infection, capable of explaining the high mortality, has been searched for, carefully, by qualified investigators without success in a fairly large number of cases (probably many more than the writer has found record of), we may assume with some confidence, that none such is present. The clinical as well as the post mortem evidence, so far accumulated, is decidedly against the existence of such a cause; while the evidence in favor of ordinary severe types of infection, particularly, the streptococcus is very strong.

Ludwig, whose description of the clinical course, has remained the standard up to the present, said that in the

first four or five days, the constitutional symptoms were not severe, but became so later. From a study of 104 cases collected from the literature and his own two, the writer believes that this change in gravity of the constitutional symptoms, has a definite relation to the invasion of the mouth and pharynx by the phlegmonous process: and that the increase in severity is out of all proportion to the increased area infected, and the corresponding amount of toxins absorbed. This raises the question as to whether the constitutional symptoms are due entirely to septic intoxication, or whether they may not be due in part to interference with respiration. Davis says "whether these deaths are due to suffocation or heart failure caused partly by sepsis and partly by the impeded respiration is sometimes difficult to say." He also adds that "these sudden deaths occur usually in patients in which the epiglottis and larynx are affected and the dyspnoea marked." One would infer from this statement that Davis believes that these sudden deaths are the result of the affection of the epiglottis and larynx. The writer believes that practically all deaths in Ludwig's Angina are to be accounted for in the same way. Some develop pneumonia and pleurisy, while a few may die of septic intoxication. Engelman says that seventy-five per cent. of children dying of diphtheria have broncho pneumonia. Diphtheria is a severe infection of essentially the same parts of the throat as are involved ultimately in these cases of Ludwig's Angina, and broncho pneumonia should be as likely to result in one as in the other. Septic intoxication, itself, probably, kills no more patients suffering from Ludwig's Angina, than do these same types of infection occurring in other parts of the body, as in the palm of the hand, the forearm or leg, or in other parts of the neck. "In Robertson and Biedert's case," Davis says "sudden death occurred after a tracheotomy had been performed, so that suffocation could not have been the cause." While it would be difficult to show that suffocation, actually, occurred in this case, the fact that the first symptom complained of was dyspnoea, and that six hours after the onset

it was so severe that tracheotomy became imperative, points to the fact that disturbance of the respiratory tract probably killed the patient. In this case as in most of the 14 which Semon reported, the phlegmonous process, evidently, began close to the larynx. In Semon's cases extension to the lungs or pleurae occurred in 5 out of the 6 fatal cases. Pneumonia developed in 3, in one on both sides, and in two double pleurisy was present. In two of the eight cases, which recovered, a double patchy pneumonia was noted. On the same point Davis says further: "In one of Ross' cases, likewise, sudden death resulted while the opening existing through the larynx was sufficient to preclude respiratory obstruction." In this case the focus from which the phlegmonous inflammation extended was, evidently, the necrotic wisdom tooth, and from this focus pus and gas escaped on prying away the tooth. With the beginning of the process only about two inches away from the larynx and within the mouth close to the pharynx, it is more than likely that oedema of the larynx developed early. On the fourth day after operation, two patches of impaired resonance were made out, one in each lung. It would seem to be evident, therefore, that in both these cases, the invasion of the respiratory tract and not septic intoxication, caused the death of the patients. Why these cases in which the clinical evidence of oedema of the glottis, *i.e.*, the intense dyspnoea, is so pronounced as to demand immediate tracheotomy do not recover when this operation permits an apparently free passage of air to and from the lungs the writer is not prepared to explain. That the deaths in these are, indirectly or directly, the result of the invasion of the respiratory tract, larynx alone or larynx and lungs, the writer believes. One of his own cases breathed through the tube after the tracheotomy had been performed, but could not be kept alive by artificial respiration. In one of Baker's cases, tracheotomy was done soon after his admission to the hospital, but the pulse stopped during the operation and the patient died. The autopsy showed oedema of the glottis (see autopsy cases). In one

of Tissier's cases, tracheotomy was performed for intense dyspnoea on the day of his admission to the hospital, the third day of the disease. Notable relief followed the operation, but the patient died the same night. In Weiss' case, a tracheotomy was done on the first day of the disease. It was necessary to continue artificial respiration for a half hour to revive him. He recovered. Fenwick's case required a tracheotomy, 4 hours after the beginning of the disease. Great relief followed the operation, but the patient died three hours later. In Gibson's case, swelling began in the neck below the lower jaw, at noon of one day. On the following day the swelling was enormous, extending to the chest and zygoma. The floor of the mouth was considerably thickened, and there was slight dyspnoea. He was admitted to the hospital about 1 P.M. At 3 P.M. of the same day, he became intensely dyspnoeic and tracheotomy was performed immediately, followed by artificial respiration. He recovered and the respiration became normal. On the next day at 11 P.M. there was dyspnoea and considerable cyanosis of the face and lips. He gradually became comatose and died at 3.15 P.M. The autopsy showed oedema glottidis (see autopsy cases). There can be little room for doubt that in all these cases the essential cause of death was the invasion of the respiratory tract, larynx alone or larynx and lungs. Septic intoxication, probably, played only a secondary part in bringing about the fatal result.

It is well known that the partial obstruction of the pharynx from faucial and pharyngeal adenoid growths, will impair the general health of a child by interfering with the normal respiration. Much greater interference coming on suddenly in Ludwig's Angina, from pushing the tongue upwards and backwards and crowding the mouth and pharynx should produce a more serious deleterious effect upon the general condition, the signs of which will be added to and confused with those of the septic intoxication which is already present. When we take into consideration the fact that there was oedema of the glottis in, practically, every fatal case in

the writer's group of cases, in which the larynx was afterwards exposed at autopsy, it becomes evident that the interference with respiration is greater than is generally supposed. Dyspnoea was noted in nearly all the fatal cases, and in the opinion of the writer it is the invasion of the larynx and lungs, not the septic intoxication, which is the peculiarly dangerous feature of Ludwig's Angina. It is sufficient to explain the high mortality, septic intoxication is not.

While in most of the cases it is difficult or impossible to differentiate between the parts played by these two factors, in a few it is shown clearly that all the alarming symptoms characteristic of a Ludwig's Angina may develop in the absence of severe constitutional symptoms, as in the following. Where temperature alone is given it should be borne in mind that this was the only symptom mentioned in the report of the case, from which one could infer the degree of the constitutional disturbance; and where it is not given here it was not mentioned in the report, and any statement implying the degree of constitutional disturbance or absence of it was extracted and employed in these brief summaries. In one case reported by Huguet and DeBovis, there was an extensive submaxillary swelling, "enormous" sublingual swelling, dysphagia, dyspnoea and a considerable quantity of fetid pus; yet the temperature never went above 39°C (102°F). In one of Parker's cases, the usual severe symptoms were present except dyspnoea, which may have borne some relation to the presence of a discharging sinus in the floor of the mouth. This may have checked the progress of the inflammation towards the larynx. The general health was not impaired. In another of Parker's cases, the general health was reported to be good. Leube's case, which underwent resolution, had a normal temperature. In Trump's case and in three of Davis' cases, the temperature was only 101°F. In Margerison's, the temperature was 100.8°F, pulse 104, and in Humphrey's it was never above 100°F. Leterrier reported that in his case the general condition was good, the temperature 37.4°C (99.3°F) and that the patient

would have taken food if he could swallow. All these cases recovered. Michel's patient was admitted to the hospital on the 5th day of the disease, when he had an enormous submaxillary swelling. On the day preceding admission asphyxia was threatened. He died 4 hours after admission. The temperature was given at 39°C (102°F). One of Schwartz's cases, on the day of admission to the hospital, insisted on going out again to attend to some business, which he was permitted to do. He returned later in the day and died of syncope that night. In Gibson's case, the submaxillary swelling began at noon of one day. On the following day at 1 P.M., when he was admitted to the hospital, the swelling was enormous. A little later the dyspnoea became intense. Tracheotomy was performed and artificial respiration carried out with relief to the patient. At 3 P.M. of the same day he died in coma and dyspnoea. Yet the temperature on admission, 2 hours before death, was only 97.8°. In Fenwick's case, the swelling began in the morning. Two hours later the face was almost unrecognizable. In 4 hours he was cyanosed and could hardly breathe, and in 7 hours he was dead. Yet the temperature was norml, the pulse 140. It would seem, therefore, that in some cases essentially all the symptoms of a Ludwig's Angina may be present, and those of septic intoxication be very moderate or practically absent. Indeed, in only a comparatively small number of the cases collected by the writer, was high temperature referred to, and in the great majority the presence of severe constitutional disturbance could only be inferred from the general gravity of the case. Inspection of the atopsy cases, given later, will confirm this statement.

Influence of the local condition.—While definite results have never been obtained from bacteriological investigations, beyond the fact that the streptococcus is present in nearly all the cases, pure or mixed with other organisms; the study of the local inflammatory conditions have yielded more satisfactory results: The observations of Poulsen, Delorme, Semon and more recently Davis, in the writer's opinion, have

been the most valuable of recent years. These writers seemed to consider the infection from a distinctly local standpoint, and to regard the larynx as the essentially vulnerable point of attack.

Poulsen says that the deep cervical fascia in the submaxillary region is dense and resistant, and that the submaxillary salivary and lymphatic glands are enclosed in a fascial space. This submaxillary fossa communicates by means of loose cellular tissue and blood vessels with the deep retromaxillary fossa, so that a cellulitis beginning in one of these spaces readily extended to the other through this communicating passage. He explains the dangerous symptoms of dyspnœa and dysphagia in Ludwig's Angina, by an extension of the inflammation through the wall of the pharynx to the pharynx and larynx from the retromaxillary fossa. He contended that those cases beginning with a preliminary angina gave secondary involvement of the lymphatic glands in the retromaxillary fossa about the bifurcation of the carotid artery, and that the resulting periglandular cellulitis then passed through the wall of the pharynx. When the phlegmonous process began in the submaxillary lymphatic glands, as from a carious tooth or ulcer in the tongue or floor of the mouth, the overlying strong fascia gave rise to great tension so that the inflammation, seeking the direction of least resistance, passed along the communication to the retromaxillary fossa, and thence through the wall of the pharynx to the pharynx and larynx. Poulsen's conclusions are not based upon strictly anatomical studies, but upon the results of his lime injections. When the lime was injected under the deep fascia in the submaxillary region, it first produced a swelling in this region which was soon followed by extension to the region of the large vessels of the neck, and almost simultaneously to the alveolo-lingual sulcus in the floor of the mouth. In no case did it work its way through the wall of the pharynx, the path by which Poulsen claimed that the inflammation reached the larynx. He obtained hospital statistics of 530 abscesses of the neck, of which 251 occurred in the submaxillary region. Of the 251, there was a swelling in the floor of the mouth or alveolo-lingual sulcus in 22. In 2 of the 22 there was a spontaneous opening in the floor of the mouth, in one at the orifice of Wharton's duct. As a rule the inflammation

subsided after incision in the submaxillary region, and only twice was the œdema so abundant that an incision in the mouth was necessary. Of the 251, 11, or 4 per cent., died. Poulsen considered that only three corresponded to the clinical picture of Ludwig's Angina, in which he attached especial significance to the non-fluctuating swelling in the submaxillary region, the lack of large pus foci, the intact skin, and the extension of the swelling to the floor of the mouth. He eliminated one of these because of the absence of an autopsy. The writer has included the other two in his collection of cases, and they will be found among the autopsy cases.

The two points in Poulsen's paper, to which the writer attaches greatest importance are: first, that Ludwig's Angina results from the extension of an infection of the neck to the larynx and pharynx; and secondly, that the cellulitis had its origin in extension from the lymphatic glands. He was far, however, from proving the path of extension. His most important evidence lay in the fact that in several cases, when the abscess was opened the finger of the surgeon could be passed down to the pharyngeal wall, the infection being traced in this way nearer to the pharynx and larynx than in any other direction. He attached considerable significance to the fact that in one case, not regarded by him as a Ludwig's Angina, during the making of an external incision into the abscess, there occurred a spontaneous opening into the throat. In no cases did he demonstrate an opening in the pharyngeal wall. Spontaneous openings have been reported rather frequently, generally in the mouth, some of them occurring near the base of the tongue or in the throat, and are readily explained in another way.

As the result of his clinical observations and experience Delorme concluded that Ludwig's Angina was nothing more than a sublingual phlegmon; although on account of its exact anatomical seat and constant symptoms, he was inclined to view it as a morbid entity and to retain the name of Ludwig's Angina. Leterrier in his thesis, already referred to, offered two arguments to support Delorme's theory. In the

first place it was found necessary in all their cases to cut through the mylo-hyoid muscle from the neck, and, therefore, into the sublingual tissues, before pus was reached. In the second place, according to Leterrier, the almost constant swelling in the floor of the mouth and the elevation of the tongue, could be due only to a sublingual phlegmon. He also added that when there was a spontaneous opening made by the pus, it was usually internal. He believed that if this theory was generally accepted and the external incision extended deeply enough, the mortality would be much diminished. All of their cases recovered. A number of writers, particularly in France, accepted Delorme's view and reported Ludwig's Angina as synonymous with sublingual phelgmon. Huguet and DeBovis, who collected and studied 49 cases, regarded them as sublingual phlegmons, but held that "these sublingual phlegmons can only be the result of diffusion of an inflammation developed more posteriorly in the region of the parotid or angle of the jaw." They believed that its anatomical seat was intramuscular, *i. e.,* that it was a basic glossitis. They could not admit that a purulent collection under the mucous membrane in the floor of the mouth would produce a hard, non-fluctuating swelling; and they added that some surgeons who have intervened by the mouth have not met with success or have had to plunge the bistoury to a considerable depth.

With reference to this point the writer has investigated his 104 collected cases with the following rather indefinite results. Nelaton made a sublingual puncture, only blood escaping. Later he made two external incisions, one a suprahyoid incision exposing a putrid focus, the other a submaxillary incision only infected serum escaping. Death resulted from syncope. No autopsy. Chauvel made a double sublingual incision and exposed a gangrenous focus above the mylo-hyoid muscle, extending to the upper border of the thyroid cartilage. (Extension to the thyroid cartilage implies that the focus was below the mylo-hyoid muscle also, and therefore in the neck.) Dubois found phlegmonous pus

by a sublingual incision. Haering made buccal scarifications but found no pus. Cuffe made a buccal incision toward the posterior part of the tongue but found only blood. Later the incision was repeated and pus was found. Holthouse made buccal scarifications but found no pus. Ross found no pus by a sublingual incision, but with an external incision located a large abscess. Ripault evacuated 2 or 3 cupfuls of pus by a buccal incision, and by a median external incision also found pus. There were sublingual and retromaxillary fluctuation in this case.

In most of the cases, however, it was the external incision which located the pus, and in only a few was the mylohyoid muscle said to be divided. The writer will show later that the sublingual phlegmon is the result of extension in the great majority of the cases, and that it is not the primary phlegmon as Delorme maintained. Leterrier explains the origin in the sublingual tissues by assuming that the infectious germs gaining entrance by a focus in the mouth as a carious tooth or an ulcer, are carried by the lymphatics to the cellular tissue about the sublingual gland. He says also that Richet has described a chain of lymphatic glands arranged in a horse shoe manner along the internal surface of the inferior maxillary bone, thus implying that if these glands existed, they would explain the frequency of cellulitis by periglandular extension.

Semon's paper, which appeared in 1895, is the most recent to attract wide attention. His conclusions are based upon clinical observations on 14 cases, which he saw in 20 years of special practice as a laryngologist. The main conclusion he reached was that "these acute septic inflammations of the throat and neck, described by a large variety of terms, such as acute oedema of the larynx, oedematous laryngitis, erysipelas of the pharynx and larynx, phlegmon of the pharynx and larynx, and Angina Ludovici, are pathologically identical. They merely represent different degrees of severity of one and the same septic process due to invasion of the throat and neck by various micro-organisms." He

adds that this can be finally proved only by a harmonious combination of clinical, pathological and bacteriological evidence. In every one of his cases, except the first he had tried to obtain a bacteriological investigation, but only in the last was this opportunity afforded, and then the evidence was purely negative. He called attention to the fact that Virchow could not exactly define the mutual relationship between erysipelatous and phlegmonous affections. Semon believes that the question of the primary localization and subsequent development depends, in all probability, upon accidental breaches of the protecting surface, through which the pathogenic microörganisms gain entrance to the tissues.

According to Semon, therefore, we are not concerned with any particular infection, so much as with a special type of inflammation, an acute septic phlegmonous process, which may be due to various microörganisms. Lockwood, who studied this condition from the bacteriological side, reached the conclusion that Ludwig's Angina is a mixed infection of the most complicated kind, and that several pathological conditions are included in this affection. He found that usually the streptococcus was present, though not always; and that this microörganism may be present alone or associated with other organisms, as the staphylococcus. From his study of the subject the writer prefers to accept Semon's view on this point. The complicated nature which Lockwood assigned to this infection, becomes simplified by the fact that whatever microörganism is found, the process is always the same, a rapidly spreading phlegmonous infiltration of the cellular tissues. This is the result usually produced by streptococcus infection, and it may be due to staphylococcus infection. Gasser quotes Queno as saying that any of the pyogenic organisms may be found in these cases. Other organisms may also produce it, as the bacillus of malignant oedema, which Lockwood found in one of his cases. We are not yet familiar with the exact results produced by the various bacteria, and Semon's statement seems sound that " it is absolutely impossible to draw at any point a definite line of demarcation be-

tween the purely local and the complicated, or between the oedematous and suppurative forms."

Semon maintains, however, that all acute septic phlegmonous inflammations of the throat and neck should be classified together, and that Ludwig's Angina as a separate disease should be eliminated. That they are all pathologically identical and that the throat, *i.e.,* the larynx, is the most vulnerable point in all, the writer believes. From the standpoint of prognosis and treatment, however, there is a very practical difference between those in which the phlegmonous process begins in the throat and those in which it begins in the neck, where the condition described by Ludwig had its origin. Many of the latter have shown a preliminary angina, it is true, but this usually disappeared later and did not form a part of the phlegmonous process beyond serving as the portal of entrance for the microörganisms. In most of Semon's cases and in one of the writer's collected cases, the acute septic process began in the throat and spread out from there. These in the writer's opinion, form a distinct group, and are laryngological; those which Ludwig described are distinctly surgical and in the majority of cases respond to surgical treatment. The following advice given by Semon, may be proper for the former but not for the latter. "Should there be anywhere distinct fluctuation or merely justifiable suspicion of such, of course you will incise upon such foci. Our promise for the future must depend on the fact that we have a bacterial infection, and that by the injection of an appropriate antitoxine we may be able to save the patient." Fluctuation or even a suspicion of it is practically never present. Prompt and suitable incision in the absence of any sign of fluctuation, has arrested the progress of many cases, probably, after oedema of the larynx had already set in. Antitoxines may be employed with advantage after incision and drainage have been provided, but not before.

No fact is more evident from a study of the literature, or is so generally conceded, than that the cellular tissue is

the essential seat of the inflammatory process, and that the surrounding structures become involved by contiguity. The literature also shows clearly, notwithstanding the claims of Delorme and his followers, that in the great majority of cases the cellulitis originates externally in the submaxillary region and not in the sublingual region, *i.e.*, in the mouth. Of the writer's 106 cases, in 61 the swelling was first noted in the submaxillary region of one side. In 16 it was bilateral and under the jaw when first seen by the physicians reporting them. In 2 there was a submental swelling which may have been a bilateral submaxillary involvement. In 13 others the swelling was described as involving the cheek and neck, face and neck, parotid region, etc., *i.e.*, it was in the beginning an external swelling. Of the 106, therefore, 92 began in the tissues of the neck external to the mouth and throat. In 8 cases the first swelling was sublingual, and from the description in 3 (Huguet and DeBovis 2, Holthouse 1) the writer considers it doubtful whether a sublingual or a submaxillary swelling first appeared. In two cases (Tordeus and Aldrich) it was described as a submaxillary and sublingual swelling. One case began in the throat as in Semon's cases, and is included here because it was considered by the writers reporting it as a Ludwig's Angina. The writer regards these facts as of much value in establishing the nature of the disease, and considers that they support what Ludwig claimed, that the cellulitis begins in the submaxillary region, at least, in the great majority of cases. Those which begin in the mouth can be easily accounted for, but there has been much dispute concerning the submaxillary origin and the term, idiopathic, has been employed in connection with them. Semon says "A little abrasion on the side of the neck exposed to the action of those pathogenic organisms may, of course, invade the body from the outside and may cause what has hitherto been called an Angina Ludovici. The original focus is purely accidental." One would infer from this that Semon considers that from such an abrasion, invasion occurs by direct continuity of tissue until the throat is involved.

Davis says: "When the teeth are the starting point the inflammation involves the periosteum of the lower jaw and thence invades all the surrounding tissues. While the point at which the infection starts localizes the disease at its commencement, it progressively spreads and invades all the tissues within its scope. No matter how it commences it spreads along the connective tissues by direct continuity. It is not transmitted by the lymphatics. The lymphatic glands do not become enlarged by infection carried to them by the lymph stream from the infectious focus, but they are involved in the connective tissue surrounding them." As already stated Leterrier considered that the infection was transmitted from some focus in the mouth to the cellular tissue about the sublingual gland setting up a cellulitis there. Roser believed that the infection was transmitted to the submaxillary salivary gland, and that the extension occurred to the surrounding cellular tissue.

That the primary focus in the great majority of cases is some insignificant lesion in the mouth, as a carious tooth, an herpetic or other ulcer, a tonsillitis, etc., has been generally admitted and so far as the writer can learn has never been denied. In many, however, no such focus was discovered. If the infection gains entrance to the tissues by such a focus in the mouth and the signs of inflammation first appear in the submaxillary region, external to the mouth and some distance from the original focus, the process can not be said to have extended by direct continuity of tissue. This applies with greater force to those in which no preliminary focus could be found, the typical, so-called, idiopathic cases. The writer's statistics on this point will be found later in connection with the clinical course of this condition.

There can be only one explanation for such a transference of infection, and that is by way of the lymphatic vessels to the glands in the submaxillary region. Most infections in this region are of glandular origin. Poulsen said that the great majority of his 251 submaxillary abscesses were cases of simple or localized adenitis, and he takes it for

granted that his cases of Ludwig's Angina began also in the lymphatic glands. v. Thadden considered it a lymphatic disease and gave to it the name "Submaxillary bubo." Localization of infection is the rule in any part of the body, and this is particularly true of those which lodge in lymphatic glands. Fulminating cases are rare. Typical Ludwig's Angina is rare and is also fulminating. It is easily conceivable that such an infection might be transferred from some slight focus in the mouth, where there is no retention, the discharge being free, to a submaxillary lymphatic gland where the infection is confined, and therefore more active, and from there on account of its increased activity invade the periglandular tissue so rapidly that its glandular origin is overlooked. In some cases the glandular origin was indicated by an early localized pain in the submaxillary fossa, which was soon followed by rapid swelling.

While the glandular origin was concealed by the rapid swelling in most of the writer's cases, this was not true of all. In one of Tissier's cases there was pain in the left submaxillary region on the first day. Swelling appeared on the following day. In one of Delorme's cases, the condition was first observed in the submaxillary region as "three glands," rapidly increasing in size. Bauer reported one in which the patient had similar attacks before. Ludwig's case in 4 days, had only reached the size of a hen's egg. One of Haering's when first seen was of the same size, Heyfelder's the size of a goose egg, and Timpe's of a five franc piece. Davis says of two of his cases, that one week before, the neck began to swell and later increased rapidly. In Blasburg's case there was an indolent swelling for 8 days and rapid swelling began on the 11th day. In the writer's case there had been a small lump for about a week before rapid swelling began. There can be little doubt of a glandular origin in these cases, and in the writer's opinion, they go far toward proving the glandular origin in the so-called idiopathic cases.

(To be continued.)

EXPERIMENTAL SURGERY OF THE LUNGS.

I. THIRTY ANIMAL OPERATIONS UNDER POSITIVE PRESSURE.

(A PRELIMINARY REPORT.)

BY SAMUEL ROBINSON, M.D.,

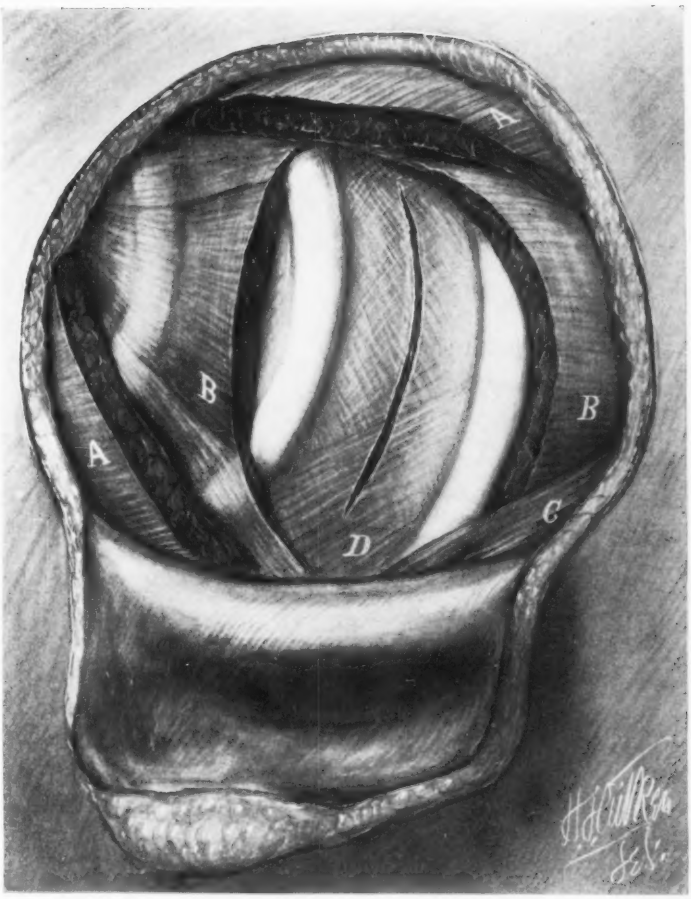
OF BOSTON, MASS.,

From the Division of Surgery and the Department of Physiology of the Harvard Medical School.

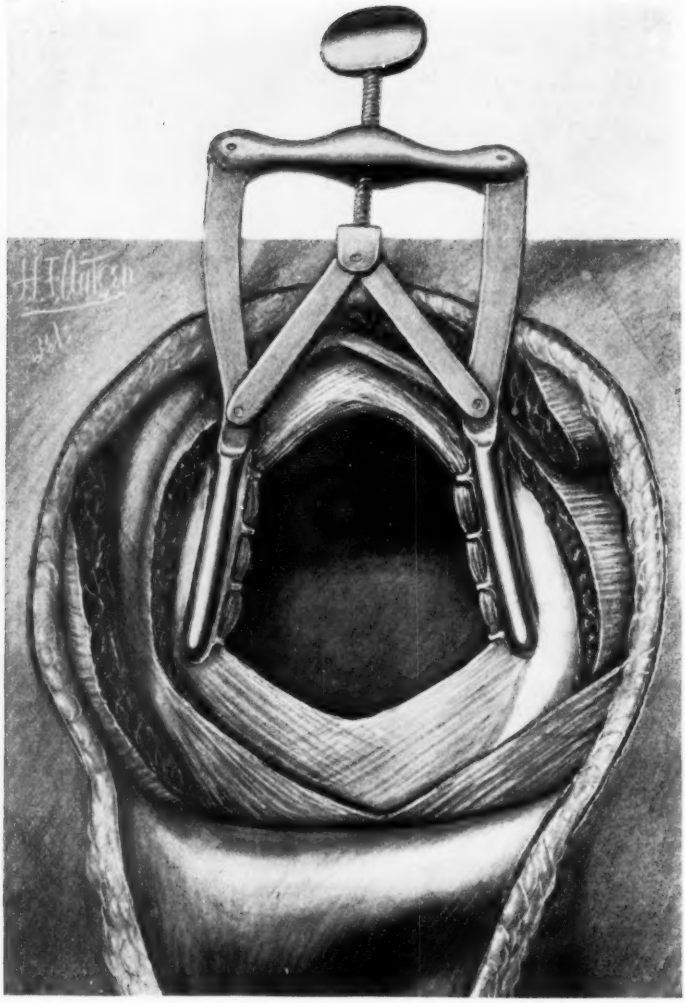
THE slow advances in surgery of the thorax during the eighteenth and nineteenth centuries are abundantly portrayed in the publications of the last ten years. I will omit them in this preliminary report. Suffice it to say that the year 1904 marks the beginning of a new epoch in the history of intra-thoracic surgery. I refer to the works of Sauerbruch and Miculicz at Breslau, and of Brauer at Heidelberg. Most publications since that date have been based on the theories advanced by these men.

The comparative infrequency of intra-thoracic operations at the large surgical clinics in this country and in Europe, indicates at once the danger which is associated with operations performed under the older methods; and we are inclined to credit the few recoveries which have occurred rather to the "Hand of Providence" than to the skill of the operator.

Successful operations in the pleural cavity demand at least one factor,—the avoidance of lung-collapse. If atmospheric air is allowed to enter and remain in the normal pleural cavity the lung will collapse. The effect of lung collapse is a series of circulatory, nervous, and respiratory disturbances which, if collapse is continued, result in death. A discussion of the many theories as to the pathology of pneumothorax will be included in a second paper. The fatal effects of collapse of the lung must be avoided in one of two ways. Air must not be allowed to enter between the visceral and parietal



DRAWING I.—Gridiron thoracic incision with skin flap. (AA) Pectoral muscle. (BB) Thoracic portion of rectus divided. (C) Upper fibres of external oblique. (D) Fascia covering intercostals, incised between 5th and 6th ribs.



DRAWING II.—Showing use of rib-spreader. Jaws including intercostal stumps and pleural edges.

layers of the pleural cavity, thus forming an actual "pleural space" or else the lung must be kept artificially inflated. The former is the key note of all the older methods of avoiding collapse in operations in the chest. A safe operative field if not already caused in the form of inflammatory adhesions between the two pleural layers, has been produced by the artificial formation of such adhesions through injections of irritating media, by prophylactic suturing of the pleura layers around the field to be operated, or lastly by the immediate withdrawal into the pleural opening of a lobe of the lung, thus preventing the further entrance of air, at the same time preventing the actual retraction of the lung towards its root, which in itself is sufficient to cause circulatory changes which result in threatening symptoms. The disadvantages of these earlier methods of avoiding collapse are self-evident. Inflammatory processes cannot always be trusted to connect the parietal pleura with deep-seated abscesses, thus giving clinical evidence of their localization, and a walled-off channel for their approach. It is also apparent that in the absence of such localized signs, an artificially produced adhesion, as by the use of chloride of zinc or suture, may not be made at a point through which the cavity to be emptied can be reached. Such mistakes lead to unnecessary probing of normal lung tissue in the vain search for pus.

If an operator ventures the risk of pneumothorax by opening the cavity and withdrawing a neighboring lobe through the wound to prevent collapse, he immediately obstructs his approach to exploratory procedures and at the same time causes respiratory and cardiac disturbances by the irritation of the vagus terminals from manipulation and traction of the lung. (See sections of tracing at this stage of operation.) Releasing the traction will again be attended with signs of lung collapse. A certain amount of intra-thoracic work can be done before threatening symptoms require the replugging of the wound. Such operating is, however, too precarious to permit of due care,—the danger point is constantly too imminent.

The one salvation then of these methods of operating is the presence of adhesions and it seems reasonable to assume that the majority of successful intra-pleural operations have been done in the presence of such adhesions; in fact most lesions of this region are accompanied by more or less inter-pleural involvement.

Until free exploratory pleurotomy and intra-thoracic inspection become thoroughly safe procedures the advance of intra-pleural surgery must be restricted.

The recent somewhat promising wave of advance is along the lines of artificial inflation of the lungs by means either of negative pressure, applied to the outer surface of the lungs, or positive pressure to its inner aerating surfaces. Since the seventeenth century, varieties of artificial respiratory apparatus have been used in physiological laboratories to prevent lung collapse during experiments on the respiratory and circulatory apparatus.

In his publication of 1904 Sauerbruch [1] states his objections to the use of such positive pressure respiratory apparatus for experimental surgery in which the recovery of the animal was desired. His objections are as follows:

1. The change in the method of breathing. (That is to say rhythmically inflating the lungs regardless of the normal reflex mechanism of breathing.)

2. Interstitial emphysema of the lung, as result of the artificial inpumping of air into the lung.

3. The effect on the circulation.

4. The persistence of a pneumothorax at the abandonment of the artificial inflation.

5. The great loss of heat.

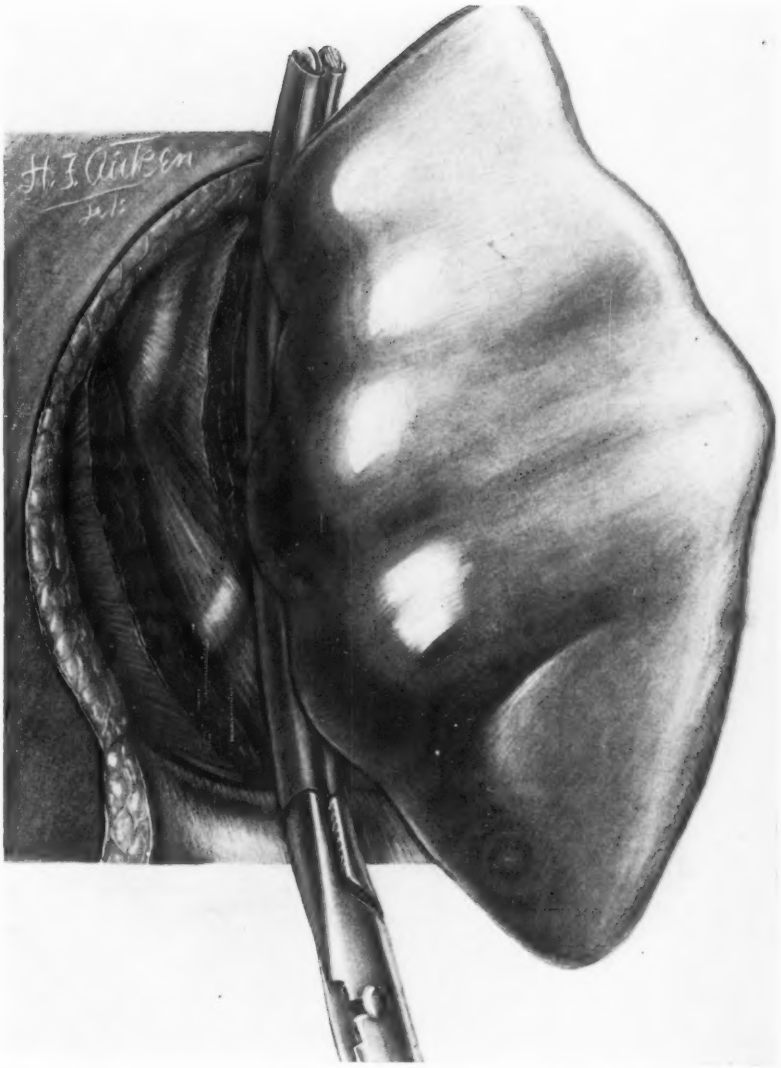
6. The great danger of infection to the pleura as a result of the extensive exchange of air in the pleural cavity.

7. The necessity of tracheotomy.

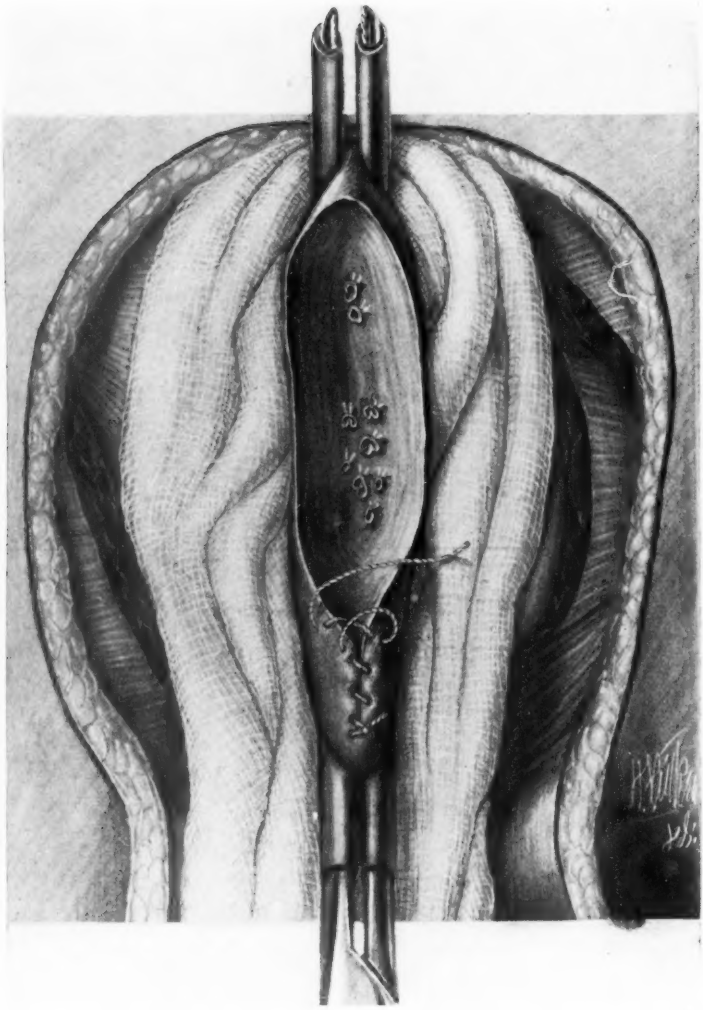
8. The difficulty of narcosis.

Sauerbruch, therefore, constructed the pneumatic chamber which is now well known. To describe briefly, the

[1] Mittheil a. d. Grenzgebieten z. Medizin u. Chirurgie, xiii, b. d., p. 399.



DRAWING III.—Lower right lobe withdrawn and clamped.



DRAWING IV.—Showing boat shape of stump and beginning of first row of inverting sutures.

operator and assistant, and the patient's body and extremities are within the cabinet, the head protruding through a rubber drum at one end into the outside air. The etherizer is, therefore, outside the chamber, and the anesthetic can be administered in the usual way. A negative pressure can be maintained within the cabinet which does not embarrass the breathing of the occupants, but is sufficient to prevent collapse of the lungs in intra-thoracic operations. Sauerbruch claims that by this negative pressure inflation, all of the above eight objections to the use of the ordinary artificial respiratory devices are obviated.

A few months after this publication, Brauer, who with Petersen had been experimenting with the positive pressure in Heidelberg, published an article in support of the method. He did not attempt to deny the success of the cabinet in avoiding the symptoms of collapse, nor did he enumerate objections either to its construction or possible harmful effects. He devoted himself largely to the description of his own apparatus, and refutes at great length the third of Sauerbruch's objections; namely, the disturbances of circulation resulting from the use of the positive pressure, which are supposed to be greater than under negative pressure.

The apparatus recommended by Brauer consists, in brief, of a metallic box, in one side of which a large rubber collar is inserted. The patient's head is inserted through this collar, which in turn is adjusted air-tightly around the neck. The patient's face can be watched through a glass window in the top of the helmet. Holes in the side walls, fitted with elastic cuffs, admit the etherizer's hands without leakage around them. Ether is introduced into a compressed air or oxygen conduit, which leads to the helmet. Exhaled air is provided with an exit which meets the resistance of a water column.

As stated by Brauer, the negative pressure cabinet possesses the great disadvantages of costliness and weight. The expense of construction is sufficient to render it unobtainable to other than well provided hospitals, and quite out of the

question for private work. Its size and weight render transportation impossible. It is, however, being given a practical trial as to its serviceability, with considerable success.

The objects in the following investigations were as follows: 1. To perfect a suitable apparatus for the employment of the positive pressure method. 2. To test the objections of Sauerbruch, first on the basis of practical surgical experiments and, provided these experiments were satisfactory, to further examine his statements with blood-pressure, respiratory and cardiac tracings to see whether these functions are much disturbed when a perfected positive pressure is applied.

The apparatus which I have constructed, as shown in photograph A, has proved most satisfactory. It can be recommended as practical at least for experimental surgery of the thorax, for experiments in physiology, and pathological physiology, and for anatomical demonstrations of the relations and appearances of the thoracic viscera. It obviates the necessity of an etherizer, and can readily be controlled by the person operating. For other than thoracic operations, it can be so adjusted that the anesthesia is administered automatically for an hour, without danger of over-etherizing.

Previous to the operations on dogs described below, seven experiments were performed on cats to familiarize myself with the following factors:

1. Effect of ether when applied under air compression.
2. Amount of heat required for ether vaporization.
3. Possibilities of masks of various shapes for application to animal's face for administration of ether under positive pressure.
4. Construction of apparatus to hold such mask firmly in position.
5. Effects of variations in size of afferent and efferent tubes to mask.
6. Different methods of regulating amount of anesthesia administered.
7. Results of pneumothorax with small opening.

8. Results of "wide-open" pneumothorax.

9. Results from manipulation of lungs.

10. Effect of positive pressure application under the above three conditions.

11. Effect of variations in this pressure.

12. Effect of excision of greater or less portions of either or both lungs, under positive pressure.

Having thus become familiar with the well-known fact that the thorax may be opened and large portions of the lungs removed under the influence of air pressure without causing immediate death, I commenced the following series of operations to determine how extensive operations may be performed on the lungs with a reasonable hope of recovery.

CASE I.—Operation: *Simple pleurotomy. Rib excision.* Result: *Death. Cause: Septic pleuritic effusion,* March 22, 1907. Small mongrel, weight 15 pounds. Asepsis: not thorough. Face mask poorly fitting. Simple, temporary, positive pressure device: inconvenient, favoring sepsis.

Skin and muscle flap triangular in shape to expose fifth rib near sternal end. Fourth and fifth intercostal muscles divided near 4th and 5th ribs respectively. One inch of 5th rib with attached intercostals excised and lifted from parietal pleura. Latter incised 4 cm. Action of right lung observed for half hour. Continuous cat-gut stitch with turns 8 m.m. apart picking up pleural edges, and when possible intercostal stumps. Pectoral muscle stumps approximated with interrupted stitches. Interrupted silk to skin. Time about 1 hr. 30 min. Collodion painted over wound: no swathe. Animal walking with stagger 15 minutes after removal of ether.

March 23, 1907: Temperature 103. Tail wagging. Able to stand on hind legs leaning.

March 26, 1907: Temperature 102 (normal). Respiration increased and somewhat labored: mucous membranes cyanotic. Dullness on percussion of right chest. Lying down. Died during afternoon.

Autopsy, March 26, 1907: Skin incision clean: muscle suture parted one-fourth its length. Pleura lying open below hole in muscle. Twelve ounces of sero-hemorrhagic fluid in right chest. Lung partially collapsed. Area of thickened visceral pleura over middle lobe. No fibrin or lymph. Left chest normal. Ounce of fluid in pericardial sac. Excised lung readily inflatable throughout.

Diagnosis: Leakage in wound. Pneumothorax. Pleuritic effusion: sepsis.

CASE II.—*Experiment: Prolonged application of positive pressure without pleurotomy.* Result: *No ill effects.* March 29, 1907: Black and white fox-terrier, female; weight 14 pounds. Object: To determine whether pleuritic effusion in Case I. was caused by use of positive pressure with possible congestion of lung and mechanical transudate.

Animal etherized. Positive pressure apparatus applied and animal kept under it for about two hours with 6–8 mm. of mercury resistance. Pneumograph applied to abdomen and tracings made.

Animal came quickly out of ether within half an hour of removal of cone, and was able to run upstairs to the roof.

Three days later animal appeared entirely normal and showed no cyanosis or difficulty of respiration. It was decided that there had been no ill effects from positive pressure apparatus as such.

CASE III.—Operation: *Simple pleurotomy.* Result: *Recovery after localized empyema.* April 2, 1907: Same dog as Case II. Object: To improve on technique of closing pleural cavity hermetically. Asepsis not thorough.

Curved incision in anterior right thorax, making semi-circular skin and muscle flap, diameter 2½ inches. Internal and external intercostal muscles of 5th interspace dissected with difficulty away from parietal pleura, leaving interosseous field ½ inch in diameter. Interosseous vessels controlled with pressure. Pleurotomy. Respiration became deeper and less frequent: mucous membrane of mouth seen through glass mask to be cyanotic. Resistance in water column increased to 8 cm. of water. Mediastinum blown forcibly into wound. Finger introduced to posterior thoracic wall and withdrawn. Attempt made to suture pleural edges but latter had retracted under ribs so that perfect approximation was impossible. Air could be heard rushing between turns of continuous stitch at respiration. Trusted that interrupted cat-gut suture to muscle and silk to skin might render flap means of air tight closure.

Immediately after recovery from ether respirations were somewhat labored.

April 3: Temperature 106; respirations 40; pulse 160. Inclined to lie down.

April 4: Temperature 105; respirations 45; pulse 170. Swathe and dressing soaked with serous discharge. Removed. Air heard sucked in and out of chest through wound. Dressing applied with pressure.

April 5, 6, 7: Eating well. More active. Stitches out on fourth day. Wound septic but granulating. Free access of air in and out of cavity was noted.

Dog became normal in habits at end of one week. Profuse purulent discharge from wound continued for five weeks, and gradually granulated to closure.

Diagnosis: Air leakage in wound: sepsis: localized empyema.

Autopsy: Killed with ether, eight weeks after operation. Cohesions between original wound and adjacent surfaces of muscle and lower lobes. No fluid or pus in cavity. Lung tissue apparently normal.

CASE IV.—Operation: *Simple pleurotomy.* Result: *Recovery.* Object: To improve technique of closing cavity and to increase asepsis. Recovery of Case III was doubtless accidental, owing to early pleural adhesions localizing pneumothorax and suppuration. April 7, 1907: Brindle mongrel, female; weight 18 pounds. Careful aseptic precautions. Chest shaved. Soap and water. Alcohol. Sterile towels.

Positive pressure 4–6 mm. of mercury. Pressure introduced before pleurotomy, thus avoiding dyspnœa. Pneumograph tracings showed no change, but slight increase in depth of respiratory excursions. Gridiron incision. Semicircular flap with convexity downwards. Muscle divided separately in same curve. External oblique origin divided at right angles with skin incision exposing 5th, 6th and 7th ribs. Sixth rib incised, ¾ inch, together with half of intercostal muscles above and below respectively. Less intercostal bleeding than in Case III. Pleurotomy ¾ inch. Pleural cavity and lung not handled. Pleural stitch (black intestinal silk with smallest curved eye needles) included portion of intercostal stumps which were, of necessity, stitched to cross space occupied by excised rib. Second row continuous suture, picking up same tissues. External oblique approximate with cat-gut. Also pectoral muscle. Subcutaneous layer with catgut. Interrupted and continuous silk to skin. Time 2 hours, 30 minutes. Prompt recovery from ether. Walking in 20 minutes; breathing not labored.

April 8: Pulse 108; respirations 30. Running about. Jumps to 2-foot bench. Convalescence entirely normal. Milk diet for two days, then raw meat. Dog presented no symptoms or signs from time of operation. Wound solid on fourth day. Stitches out on seventh day. Two weeks later used again in physiological experiment.

Case V.—Operation: *Excision of tip of right middle lobe.* Result: *Death on sixth day.* Cause: Sepsis. Pneumothorax from leakage of stump. Object: Encouraged by success of Case IV, attempted to make larger pleural cavity opening with excision of piece of lung-tissue.

April 16, 1907: White mongrel, female, weight 20 pounds. Chest shaved on previous day; reshaved, scrubbed with soap, water, alcohol and corrosive. Square skin flap (3 inches diameter) reflected outwards, exposing right 4th, 5th and 6th ribs. Pectoral and external oblique muscles not at opposing angles. One inch of 5th and 6th ribs excised with intercostal muscles connecting. Just before pleurotomy animal suddenly stopped breathing. Probably due to excess of ether. Apparatus converted into artificial respiratory one, and breathing restored by twelve rhythmical inflations at intervals of about 12 seconds. Breaks in asepsis repaired, and operation continued. Parietal pleura divided diagonally across field. Tip of middle lobe ligated with catgut, and amputated ⅛ inch from ligature. Stump dropped back. Mediastinum, blown into wound by pressure from unoperated side, interfered with suture of pleura. Scalpel stuck into left chest and turned to allow left pneumothorax. Mediastinum retracted to its median position. Pleural edges approximated with continuous silk at end of wound. Two interrupted sutures in centre, the latter of which was drawn tight at end of inspiratory excursion (see correction in later operations). Pleural stitch leaking. Lateral tears due to lack of support of intercostal muscle tissue. Wound sutured in layers. Scalpel wound of left chest closed with one skin stitch. Tight swathe applied over sterile dressing.

April 17: Temperature 101.6; pulse 150; respirations 60. Dog languid, but drinking.

April 19: Temperature 105; pulse 180; respirations 75. Slight dullness elicited by percussion of right chest. Decided not to attempt secondary measures.

April 22: Died. In three days previous food and water refused.

Autopsy.—Skin and first muscle layer clean and dry. Pleural wound gaping with continuous silk stitch lying free in cavity wrapped in fibrin. Right chest contains 10 ounces of sero hemorrhagic fluid with purulent sediment. Visceral and parietal pleuræ covered with fibrinous exudate and lymph, which could be removed with finger. Lungs excised and inflated. Ligature had slipped off tip of movable lobe and air was heard escaping from pin-point opening in stump. No pneumonic or atalectatic areas in either lung. Left pleural cavity contained 5 ounces of similar fluid without fibrin shreds. Left lung normal. Cultures of pleuritic fluid saved for examination.

The operation as such of Cases I, II, IV and V, with a mortality of 50 per cent., are simple to the extreme. They are reported, however, to show the necessity of absolute asepsis and painstaking technique for the hermetical closure of the lung stump and of the chest wall. Just why a pleuritic effusion occurs in these fatal cases will be discussed in a later paper on the basis of pathological physiology. I was, however, convinced at this time by the cat experiments, and by the success of Cases II, III and IV, that the cause of fatalities must be sought, not in the positive pressure resistance to the lung, but rather in the intrinsic unreliability of the apparatus used in the above cases, in the breaks in asepsis necessitated by this unreliability, and lastly in undeveloped surgical technique. It was evident that the removal of two ribs together with intercostal musculature rendered approximation of pleural edges difficult, and that of intercostal stumps impossible. It seemed advisable also to adhere to simple pleurotomy until technique was perfected.

The apparatus used in the above cases was an improved one, consisting of a small ether bottle with rubber-tube connections for conduction of air; also an outlet tube to a water bottle. The mask was smaller than that shown in photograph A.

CASE VI.—Operation: *Simple pleurotomy. One rib excised.* Result: *Recovery.* Object: To obtain recovery after simple pleurotomy under positive pressure of improved apparatus. Two-rib excision abandoned.

July 19, 1907: Lemon and white pointer (mongrel); weight 30 pounds. Dog had been etherized under positive pressure on two days previous. Considerable mucus in pharynx doubtless resulting from the above. All aseptic precautions of a hospital surgical operation. Crescentic incision on right chest with convexity ½ inch from median line and ends approaching axilla. Pectoral muscle fibres cut transversely, also pectoral aponeurosis of external oblique. Fascia covering ribs incised over and parallel to 5th rib. Saw cut through cartilage of 5th rib ½ inch from sternum. Another saw cut 1½ inches towards axilla. Ribs then carefully dissected from parietal pleura and from its intercostal attachments. Intercostal oozing readily stopped with pressure. Positive pressure resistance increased to 7 cm. (water) by lowering glass tube in water column. Pleurotomy (1 inch). Pressure so regulated that lungs hugged parietal wall, but did not protrude through opening. Mediastinum bulging into wound, however. Respirations quiet and regular. Attempt made to reduce resistance to 4–5 cm. Respirations became labored; 7 cm. restored. After one-half hour of observations pleural stitch commenced. No. 1 silk, fine curved round needle. Suture picked up pleural edges together with intercostal stumps, which, by above method of rib excision, lay in close apposition to pleural edges. Turns ⅛ inch apart. At one point, however, where pleura was devoid of intercostal support, a cross tear occurred after continuous stitch was tied. Repaired by a cross stitch. Still some air leakage. Second continuous row of sutures, including fascia covering intercostal and picking up pleural stitch, prevented further leakage. Catgut to muscle layers. Pagenstecher's linen to skin.

Dog allowed out of ether too soon before swathe was applied. Considerable unnecessary strain on stitches resulted. Under ether 2 hours.

July 22: Temperature 102.2 (normal); pulse 82, irregular; respirations 26. Languid.

July 24: Temperature 104.4; pulse 54, irregular; respirations 20 (normal). Active: apparently in normal condition.

July 25: Stitches removed: slight redness in ½ inch of incision. Cotton collodion cocoon.

July 27: Cocoon removed: wound clean and dry. Dog well. Temperature 101. Pulse 94; respirations 20.

Sept. 16: Since last note dog's convalescence has been normal except for diarrhœa and loss of weight following ingestion of stale meat. He recovered from this before autopsy. The pulse has been irregular since operation.

Autopsy, Sept. 16, 1907: Dog killed with ether. Line of incision clean and indistinct. Slight fullness at lower end about size of a pea. One dram of pus escaped from this point and was traced to a small cavity in muscle layer containing a free chromic gut stitch. Muscle union firm and adherent to pleural suture below. Pleural scar divided. Adhesions from between pleurotomy wound and pericardium (probably explaining irregularity of pulse). Light easily broken adhesions between pleurotomy scar and adjacent surfaces of middle and lower right lobes. Lungs

excised and inflated. Found to be normal throughout. No hemorrhagic, emphysematous or consolidated areas seen macroscopically.

CASE VII.—Operation: *Simple pleurotomy. One rib excised.* Result: *Recovery.* Object: To repeat operation of Case VI, to improve rib resection and suturing. At this time resection of rib seemed to me imperative to obtain room enough to operate on lungs.

July 20, 1907: Fox-terrier, male; weight 20 pounds. Technique identical with previous operation except that intercostal muscles were carefully preserved and no lateral tears occurred in pleural stitch. Dog came out of ether slowly, and when left in recovery room was unable to stand. Prognosis looked unfavorable.

July 21: Dog lively and active as before operation. Milk diet taken eagerly.

July 22: No symptoms; solid food.

Summary of daily chart:

July 22: Temp. 102; pulse 100; resp. panting with heat.
" 24: " 102.6; " 120; " " " "
" 27: " 102; " 90; " 25
" 29: " 102; " 105; " 23

Skin stitches infected and removed on the 5th day. Secondary healing in two weeks.

Sept. 24: Convalescence has been normal throughout. Dog killed with ether.

Autopsy: Right chest opened in 7th intercostal space. Finger introduced and pleural surface of original pleurotomy explored. Smooth serous covering at this point with no adhesions to pericardium or lungs. No fluid in cavity. No adhesions between lobes of lungs. Layers of thoracic wound firmly cicatrized and free from signs of infection.

CASE VIII.—Operation: *Simple pleurotomy, 2-rib excision.* Result: *Recovery; after localized empyema.* Object: To attempt a larger pleural opening before attempting lung resections. Sub-periosteal resection attempted, but found difficult with such small structures. Attempted two-rib method again.

July 21, 1907: French bull bitch (white); weight 20 pounds. Grid-iron incision down to level of ribs. Fifth and sixth ribs each sawed near costochondral articulation, and again one inch and a half nearer axillary line. Both sections together with 5th intercostal muscle group removed, leaving stumps of 4th and 6th intercostal muscles as long as possible. A right angle tonsil-knife was successfully used to separate ribs from pleura. Sub-periosteal resection of rib not practical in small animals. Pleurotomy of one inch. Respirations under pressure observed, but pleural cavity not disturbed. Mediastinum inclined to puff into wound, especially during forced expirations when ether was "light." Pleural edges alone approximated with provisional mattress stitches later drawn up through pectoral muscle and tied. Intercostal stumps could not be stretched across space left by two-rib excision, so pectoral muscle was sutured over pleura. Approximation of this layer poor at sternal end. Pectoral muscle sutured with interrupted and continuous Pagen-

stecher linen. At completion of suture slight leakage could be heard near axillary stump of 6th rib which had torn open the pleura at this point.

July 22nd: Temperature 101.6; pulse 152; respirations 56. Dog somewhat languid.

July 23rd: Temperature 104; pulse 176; respirations 84. Condition much worse. Respiration labored. Presents all symptoms of pleuritic effusion, with probable infection. Presuming that leakage was occurring in wall, an attempt was made to expand lung under pressure, together with aspiration to empty cavity and favor pleural adhesions. Seven to eight cm. (of water) pressure applied with apparatus. Trochar inserted dog's axillary line at 6th interspace. Rubber and glass tube extension to trochar. Mouth suction. One-half ounce of bloody fluid aspirated by this method. Tube suddenly withdrawn and throacentesis wound clamped and tied. Lung had thus been expanded by both positive and negative pressure. Animal apparently much revived by above procedure. Ran up three flights to recovery room. Five hours later respirations 64.

July 24th: Marked improvement. Temperature 102; pulse 120; respirations 52.

July 25th: Marked fluctuating swelling under skin flap. Skin stitches granulated at one point. Three ounces of sero-hemorrhagic fluid escaped, more than enough to have come from flap alone. Large absorbent dressing applied.

July 26th: Dressing soaked. See chart.

July 28th: Dog in fine condition. Condition has evidently become one of a localized empyema. Drainage continued. Discharge now purulent.

Sept. 15th: Sero-purulent fluid discharged from wound for five weeks, with gradual closure. Dog meanwhile active and eating well.

Autopsy, October 25, 1907.—Dog entirely normal since last note. Few adhesions connecting length of pleural incision with adjacent surfaces of lower and middle lobes. Middle and lower lobes slightly adherent at their adjacent surfaces. No fluid in cavity. Lungs excised and inflated. Both lungs normal and functional in every respect. Considering seriousness of dog's condition two days after operation, the pleural cavity showed little signs of previous disturbance.

CASE IX.—Operation: *Excision of 1½ inch tip of right middle lobe.* Result: *Recovery.* Object: Satisfied from above recoveries that simple pleurotomy with excision of piece of one rib was a reliable procedure, it was decided to adhere to this technique of closure, and to attempt excisions of lung tissue. There seemed to be reason to believe that fatalities resulting could now be ascribed to the lung excision, and not to faulty closures of cavity.

July 22, 1907: Tiny mongrel brindle, female; weight 12 pounds. Absolute aseptic precautions. One and one-half inch of 5th rib excised. Pleurotomy. Mediastinum in this case showed no tendency to blow into wound. Tip of middle lobe lying in immediate vicinity seized with smooth forceps and drawn out of wound. Tongue of lobe clamped with curved half-length blades protected by rubber tubing. Triangular piece then

amputated ⅛ inch from clamp. Continuous over-and-over stitch to stump. No vessels separately tied. Clamp removed. Two ends of stitch tied together, making stump conical in shape. Circular linen ligature at point of removed clamp. This tie yielded suddenly at end of first knot, as though cutting through. Pleural stitch satisfactory and strong. Excessive (10–12 cm.) pressure applied as knot was tied in pleural suture: with hope of driving air out of cavity just previous to closure, thus approximating lungs to thorax wall and preventing pneumothorax. Silk to muscle layers. Pagenstecher linen to skin. Binder with firm pressure.

July 23rd: Dog inactive, but apparently not sick.

July 24th: Temperature 104; respirations 26; pulse 140; question whether this temperature indicates pleurisy. Low respirations point against this possibility. Dog lies in corner, and growls when approached.

July 25th: Temperature 103; pulse 130; respirations 20. Eating well.

July 26th: Slight leakage of serous fluid at one end of wound, apparently from between layers of wall.

July 28th: Wound dry and solid. Dog lively and well.

Sept. 26th: Remained in absolutely normal condition to time of autopsy. Has gained about five pounds in weight.

Autopsy, Sept. 28, 1907.—Superficial pus formed between pectoral and intercostal layers. Intercostal layer strongly intact. Incision made in 7th space. Adhesions found between lower lobe and diaphragm; between pericardium and pleural wound, including stump of amputated lobe. Adhesions also between upper lobe and posterior thoracic wall, between middle lobe and pericardium. There was also a light adhesion between pericardium and left middle lobe. Lungs excised and inflated, and found normal throughout. A small portion of right middle lobe lacking. Stump one inch in diameter. Numerous adhesions covering stump. Specimens in toto frozen for future reference.

Case X.—Operation: *Excision one-third of upper lobe.* Result: *Recovery.* Object: Dog IX having no threatening symptoms, a more extensive lung excision was attempted.

July 25, 1907: Lemon and white fox-terrier; weight 16 pounds. Technique of pleurotomy same as in Case IX, with excision of one rib. Pleural opening, one inch. Five minutes after pleurotomy, dog's respirations became shallow and less frequent. Probably due to excess of ether. Opening closed by traction on presenting lobe, and respirations were restored to normal. Presenting lobe clamped. Amputated stump sutured with continuous over and over silk. When clamp was released profuse hemorrhage occurred. Stump transfixed twice and ligated with Von Brun linen. Stump dropped back, and pleura stitched. Pectoral muscles well overlapped, making good support of pleural stitch.

July 26th: Languid. Milk diet.

July 27th: More active. Doing better than expected.

July 28th: Somewhat sluggish. Respirations 30 and somewhat labored, but no signs of dyspnœa. Possible that respiratory stretching of pectoral muscle caused pain which gave appearance of difficulty in breathing. Lameness of right fore-leg more marked than previous cases.

July 29th: Wound clean, stitches removed. One drop of serum in one stitch hole. Dog coughs in low voice occasionally.

Aug. 4th: No coughing. Hungry for solid food.

Aug. 11th: Discharged well to roof.

Autopsy, Sept. 28, 1907 (2 months).—Killed with ether

Muscle and skin in region of incision were removed in one layer, and the pleural stitch was found solid. It is evident that there is considerable atrophy of the intercostal muscles in these cases.

An incision was then made two intercostal spaces below that where operative incision was made, and the finger introduced upwards to the pleural side of thoracotomy wound and a light adhesion was found between the middle lobe and the pleural scar. The left chest was then opened and the lungs and heart removed in toto, including sections of those ribs on the right to which right middle lobe was adherent.

The triangular piece described in account of operation proves to have been taken from a tongue of the upper lobe and the adhesions of the middle lobe was a coincident due to proximity of the same to the pleural opening. In fact, the localization of this adhesion point on the parietal-anterior surface of the lobe suggests to me that the lung must have been in a normal state of inflation immediately after the operation at a time when such contact adhesions would doubtless be formed.

The stump of the upper lobe was connected by a goose-neck adhesion reaching across to the pericardium. It was really of little apparent significance.

Both lungs inflated normally and it was interesting to compare the two upper lobes when under inflation. The stump of the resected portion of the right upper lobe was not more than a half inch in length, although the operation describes a sutured stump of two inches and a half. On comparison with the opposite lobe, however, it is evident that the apical tongue of this lobe is lacking, thus changing the shape of the parietal surface from pear shape to a more quadrilateral shape with rounding corners.

Case XI.—Operation: *Excision one-half of upper lobe.* Result: *Recovery.* Object: Satisfied that apparatus is practical when properly handled; also satisfied that technique of wall closure is proving reliable, and that asepsis is improved, determined to limit myself to simple pleurotomy with excision of more lung tissue.

July 28, 1907: Brown and white mongrel hound; weight 22 pounds. Technique of thoracotomy unaltered. One and one-half to two inches of 6th rib excised. A larger portion of presenting lobe included by clamp. After amputation two rows of continuous linen were employed to stump. Lobe transfixed once proximally to clamp at median point, and as clamp was released stump was ligated in both directions. To be noted here that a simple "curved half-length" without rubber protection to blades has been used for clamps in the above operations. Time under positive pressure 2 hours.

July 29th: Milk diet taken well.

July 30th: Takes solid food greedily.

Aug. 1st: Temperature 102.4; pulse 105; respirations 15. Somewhat inactive and lame, but not sick.

Aug. 3rd: Dressing and stitches entirely removed. Drop of pus in one stitch hole at axillary end of incision. Dog running about to-day.

Aug. 8th: Wound entirely dry and clean. Temperature 102; respirations 20; pulse 75. Aug. 11th: Discharged well to roof to complete convalescence interval of 8 weeks.

Suturing stump and thoracotomy wound consumes an apparently excessive amount of time, but the forced movements of the chest and the fluttering mediastinum, and the occasional interference of the pericardium, render careful approximation with fine needles a slow process. Lack of an assistant added to time expended.

CASE XII.—Operation: *Excision of right middle lobe.* Result: *Recovery. Death in four weeks from unknown causes.*

July 31, 1907: Brindle Boston terrier mongrel; weight 25 pounds. Object: To increase extent of pneumectomy gradually. To attempt total removal of right middle lobe.

Gridiron incision. Pectoral muscle divided transversely to fibres. Pectoral belly of rectus and fascia over ribs cut parallel to and over 5th rib. Usual rib excision, saving all intercostal muscle tissue. Intercostal arteries required tying in this case. Pleurotomy one inch. Dog not being susceptible to ether remained "light" throughout the operation. As usual in such cases, expirations were violent as though effort was being made to blow away resistance of water column. Tendency under such conditions to lung collapse is, of course, much reduced, so that the whole operation was conducted under an actual resistance of only 3 cm. of water, which, however, by voluntary forced expiration was increased to 7–8 cm. Mediastinum was consequently blown violently into wound in form of finger-cot shaped scar, as result of unequal pressure in two pleural cavities resulting at expiration in the extension of the left lung and mediastinum over to the pneumothorax side. The bulging mediastinum was walled away with gauze wick.

Tip of lower lobe seized, but found unyielding, and dropped back with laceration of tissue by use of forceps. Middle lobe then drawn well out of cavity and clamped as near root as possible with clamp remaining extra-thoracic. Stump sutured over-and-over with silk. Transfixed proximal to clamp with Pagenstecher linen, and tied in both directions as clamp was released. Mediastinal wick removed. Respirations now less forced, mediastinum quiet.

Satisfactory pleural stitch, including intercostal stumps, and fascia covering them. Slight leakage at end of wound showing necessity of carrying stitch to extreme limits of intercostal incision. Second row of sutures to same tissues. Von Brun linen continuous to muscle, continuous linen stitch to skin. Considerable bleeding in wall. Time 2 hours.

August 1st: Apathetic.

August 2nd: Languid, but not sick.

August 3rd: Temperature 102; pulse 142; respirations 40. More active. Dressing removed.

August 6th: Temperature 102; pulse 150; respirations 28. Wound entirely clean and flat.

August 8th: Temperature 102; pulse 150; respirations 24.

August 12th: Discharged well to roof.

August 26th: Dog has been normal and eating well, but never active. Question whether dog is naturally logey.

August 27th (4 weeks after operation): Dog found dead on roof, with maggots in mucous membrane. Dog fight had been overheard on previous day, but there were no superficial signs of violence.

August 28th, *Autopsy.*—Small accumulation of pus in muscle layer, with loose linen stitch in its midst. Pleural scar solid and clean.

Further report by S. B. Wolbach as follows:

The right lung is collapsed; at the apex is compact; markedly post-mortem. As viewed from behind, the middle and lower lobes are adherent to the chest wall to the 3d, 4th, 5th, 6th, and 7th ribs. From in front the pericardium and anterior border of the right lung are adherent to the chest wall, formed by the 4th, 5th and 6th ribs. A portion of the 5th rib is missing and for a distance of 4.5 cm. the chest wall is made up of fibrous tisue. On incision a pus cavity is exposed in which lie several sutures. The lower lobe of the left lung is apparently normal.

The heart is united to the pericardium by loose tough fibrous tissue over both ventricles.

Right auricle and ventricle is adherent to the chest wall below the stump of the lung; markedly postmortem; apparently normal. Tissues about stump of lung firm and clean.

Case XIII.—Operation: *Excision of 3 right lobes.* Result: *Death.* Cause: *Infection of both pleural cavities.*

Aug. 2, 1907: Tan colored bull-bitch; weight 24 pounds. Object: Excisions of individual lobes and parts thereof have been so persistently successful in the last few operations that more radical procedures seemed possible. Instead of gradually increasing the amounts excised, total excision of lobes was attempted.

Same thoracotomy technique, with excision of piece of fifth rib. Animal employing forced expiration owing to unsusceptibility to ether causing hernia of mediastinum. At one stage it was necessary to suspend operation and plug wound with gauze, at same time lowering pressure resistance to 3 cm. on account of these forced expiratory movements.

Middle and upper lobes consecutively withdrawn from thorax, clamped, amputated, sutured, and transfixed at stump. No vessels or bronchi tied separately. Ends of continuous sutures to stumps tied together.

Lower lobe treated likewise, except that two vessels were ligated before stump was sutured. Finger exploration revealed no palpable lung tissue remaining. During pleural stitch pericardium constantly flapping

into wound. Pierced twice by needle. Respiration at same rate after pneumectomy until dressing was applied and pressure removed. At this moment breathing became more rapid. Time 2 hours, 30 minutes.

August 3rd: Temperature 102.6; pulse 135; respirations 88. Dog's general appearance no different than in animals with partial pneumectomy on first day after operation, except for high respirations. Temperature seems to contraindicate sepsis.

August 4th: Temperature 102; pulse 110; respirations 65. Sluggish condition, but inclined to walk and join other dogs.

August 6th: Temperature 101.6; pulse 165; respirations 60. Sick. Respirations high and labored. Right chest dull to percussion. Dog placed on board. Trochar inserted into 5th space, axillary line; 175cc. of hemorrhagic fluid escaped. Stringy sediment at bottom of graduate (culture). Puncture wound closed with stitch. On standing fluid leaked through to dressing.

August 7th: Has refused nourishment for 2 days. Considerable improvement in general condition. Temperature 101.8; pulse 128; respirations 84. Drainage has ceased. Dog found dead at 2 P.M.

Autopsy (Wolbach).—"Skin incision perfectly healed. There is a small abscess containing about 3 cc. of pus. A piece of the 5th rib is missing. The excised portion of rib is about 4 cm. in length. There is a stump attached to the sternum about 1.5 cm. in length. The pleura of the lung is adherent to the pleura covering. The left lung above is adherent to the chest wall along the 4th rib. Below the lung is adherent to the 6th rib. On removal of the lungs a cavity containing pus is found between the lower lobe and the diaphragm. Holds in all about 50 cc. The adhesions of the lung to the chest wall are firm and fibrous in character. A portion of the middle lobe is missing. Vessels and bronchi leading to excised portions are normal. Both lungs in general are collapsed; deep red and atalectatic."

CASE XIV.—Operation: *Pleurotomy with 3-rib flap.* Result: *Death.* Cause: *Lung collapse from leakage.*

Aug. 4, 1907: Fox-terrier-beagle mongrel; weight 28 pounds. Object: Realizing that pleural opening in the above cases is too small for intrathoracic operating in general, a departure from the above technique of pleurotomy was undertaken in the form of a rib flap. Apparatus worked satisfactorily, and no breaks in asepsis were detected.

Semi-circular skin-flap exposing 4th, 5th and 6th ribs for distance of 2 inches. Gridiron incision through pectoral and upper rectus origin. Cartilages of 4th and 5th ribs cut through. Bony portions sawed through 2 inches from cartilage cuts. Intercostal muscles of 3rd and 6th spaces cut at attachment to 4th and 5th ribs respectively. Tonsil knife used to separate rib flap from parietal pleura. Pin point punctures near axillary upper end of flap. Flap now bent back towards axilla, exposing pleura to extent of area 1½ inches square. Pleura incision across diagonally to direction of ribs. Each lobe of right lung withdrawn in turn and handled. Respiratory movements continued rhythmically. Pressure so regulated that lung was constantly lying flush with wound but not protruding.

Pleura, stitched with continuous silk from either end, plus two "interrupteds" in the middle. Lack of muscle support to pleural edges resulted in lateral tears at two points which could not be permanently repaired. Considerable air leakage in and out of cavity. Flap layed over and adjoining tissues at edge of flap stitched with linen. Ends of ribs and cartilages joined with mattress stitches, taking in cartilage or periosteum. Recut stumps could not be brought together across space. Pectoral was sutured carefully, however, and leakage could not be heard. Second continuous row in pectoral layer. Skin brought to close approximation with interrupted and continuous linen. Dog out of ether and walking to leash in 30 minutes.

Aug. 6, 1907: Refused nourishment. Expirations forced and characteristic of all above cases, with effusion and collapsed lung. Identical also with breathing of Case XIII, in which there had been practically a total pneumectomy. Temperature 102.6; pulse 150; respirations 60. Temperature seems to contraindicate septic pleurisy.

Aug. 7, 1907: Found dead in recovery room at 9.30 A.M.

Autopsy (immediately).—Skin stitch tight and dry. Immediately beneath was found direct communication with pleural cavity. Pectoral suture was intact, but axillary end of pleural stitch, where protected only by outer edge of rectus, was wide open. Directly beneath skin, therefore, an effusion was encountered which proved to fill the right thoracic cavity. This effusion was fibrinous in character. Both rib segments contained in flap had broken away from their sutures. Intercostal muscles of flap showed beginning of gangrene, doubtless from lack of blood supply due to injury to intercostal vessels. The parietal pleura was adherent to the collapsed right lung, and dragged with the latter to the posterior wall. Lobes were all atalectatic.

CASE XV.—Operation: *Excision ¾ of right middle lobe.* Result: *Recovery.* Object: Two departures have been made in the last two cases from a previously satisfactory procedure: 1st, excision of four times as much lung tissue, Case XIII; 2nd, attempt at rib flap in place of single rib excision. Since both operations having resulted fatally, it was decided to return to the original technique with more gradual increase of procedure.

August 9, 1907: French bull-terrier; weight 8 kilos. Original technique of pleurotomy with excision of two inches of 5th rib. Tip of presenting lobe seized. Lobe drawn out. Amputated. Stump-suture. Transfixation and ligation. Pleural stitch leaked at one point. No leakage through 2nd muscle layer. Pectoral suture not diagonal to pleural stitch.

Aug. 10th: Dog very apathetic, lying down, head low. Purulent discharge from both nostrils.

Aug. 11th: Refuses nourishment, pus discharge from eyes and nose. Respiration 18; temperature 102; pulse 100, irregular.

Aug. 12th: Water ounces 3 by rectum. Dog sick, but respirations are normal. Suspected that languor was due to rhinitis and conjunctivitis.

Aug. 16: Walking about. Less apathetic. Eating well.

Aug. 19th: Dressing disturbed for first time. Continuous stitch surrounded with lymph, removed. This condition of skin stitch likely to occur if latter is left in more than four days. Dressing omitted.

Aug. 20th: Scabs of sawdust over stitch wound of aid in healing.

Aug. 24th: Snuffles more active. Diarrhœa profuse. Eating well, however. Pulse still ranging between 125 and 150. Temperature and respirations normal. Diagnosis, distemper.

Sept. 6th: Discharges less. No rash has developed.

Sept. 15th: No symptoms of distemper. Dog entirely well. Gaining weight.

Oct. 13th: Dog has developed no symptoms of any sort.

Autopsy (9 weeks).—Thoracotomy wound clean and solid. Adhesions between right lower lobe and lower end of pleurotomy scar. Adhesion between stump of middle lobe and the pericardium. Also between stump and pleurotomy wound. Found that one-half of cardiac (middle) lobe has been removed. A small cyst the size of a pea bean was found in stump which contained a gelatinous fluid and which, when incised, allowed escape of air through pin point opening.

Right lung tissue presents microscopically no areas of atalectasis, pneumonia or emphysema. Left lung normal. Both lungs excised and inflated. Sketch made. Specimens frozen 12 hours after removal.

Case XVI.—Operation: *Excision right middle lobe.* Result: *Recovery.* Object: To further establish the reliability of the above method of pleurotomy and partial pneumectomy.

Aug. 10, 1907: Irish terrier; weight 11 kilos. Well nourished, short hair. Rib excised without injury of pleura at any point. Pleurotomy of 1½ inches. Respirations continued to be regular and not dyspnœic. Neighboring lobe withdrawn and amputated. Stump too long for "half length," resulting in slight wrinkling. Same suture to stump except that continuous was carried across and back. Stump transfixed and ligated.

Wall layers as follows: 1. Pleura and internal intercostal. No leakage after this suture. 2. External intercostal and fascia. 3. Pectoral and few cut fibres of external oblique. Apparatus satisfactory. Pulse 180 at end of operation. Temperature subnormal, 100.4. Respirations 60. Technique interrupted twice: 1. Cleaning mucus from cone. 2. Refilling ether bottle. Operation on whole more satisfactory than those above.

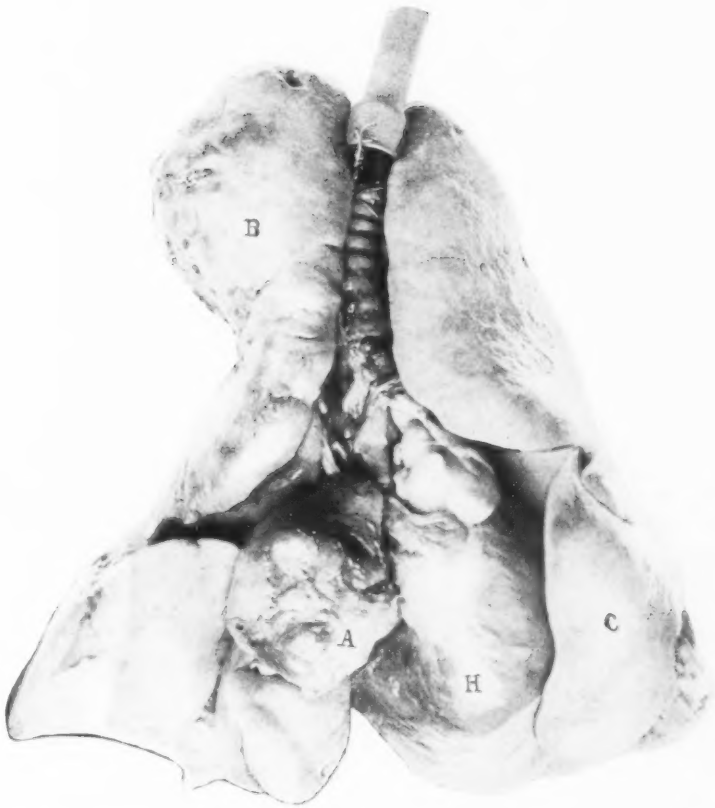
Aug. 11th: Solid food. Walking. Temperature 103.2; pulse 130; respirations 30. Prognosis good.

Aug. 12th: Pulse irregular. (See autopsy for pericardial adhesions.)

Aug. 15th: Stitches out; wound clean. (See chart of Case XVI.)

Oct. 10th: Eight weeks since operation. Dog has had an uninterrupted convalescence.

Autopsy.—Thoracotomy below original scar. Finger introduced and the under surface of pleurotomy wound palpated. It was covered with serous membrane and there were no adhesions except one to the pericardium, which was easily separated. The lungs were excised in toto and



CASE XVI.—Excision of right middle lobe. (A) Stump of excised lobe. (B) Right upper lobe. (C) Left middle lobe. (H) Heart.

inflated. After separating adhesions between stumps and adjoining surfaces of upper and lower lobes, it was found that all but a small portion of the right middle lobe had been excised. Specimen frozen. Thawed out, inflated and photographed five weeks later. The lungs and pleural cavity were otherwise entirely normal.

CASE XVII.--Operation: *Posterior thoracotomy.* Result: *Recovery.* Object: It was evident that full traction on middle lobe through small anterior thoracotomy wound did not render root of this lobe extra thoracic. In other words, amputation of a lobe by anterior approach with small opening did not remove all of the lung tissue of that lobe. A posterior attack was undertaken. Simple thoracotomy for technique was first attempted.

Aug. 24, 1907: Brindle-pup, long ears, long legs; weight 24 pounds. Dog etherized on back, then turned to prone position on board. Cone and apparatus adjusted readily by placing chin rest under lower jaw. Shaving of coarse hair of back more difficult. Preparation otherwise the same. Semicircular flap as near scapula as possible, exposing muscle over second and third ribs. Muscle external to erector spinæ group (corresponding to trapezius and latissimus fibres) divided transversely. Rib excised as in ventral operation. Wound sutured in layers by usual gridiron method.

Aug. 15: Condition good. Appeared normal in all respects. Respirations 30.

Aug. 20: Chart normal. Temperature 102; pulse 100; respirations 20.

Aug. 22: Skin stitch parted for distance of 2 inches. No infection. Secondary suture, with wick remaining.

Aug. 27: Secondary skin suture suppurating, but considerable gain has resulted from attempt.

Sept. 2: Distemper symptoms. Dog in room previously occupied by Case XV, with distemper. Food taken well. Pus from eyes and nose. Diarrhœa.

Sept. 19: Fell out two story window and broke femur of right hind leg. Swelling appeared under operation flap.

Sept. 21: Five weeks since operation. Dog killed with ether on account of broken leg.

Autopsy.—One ounce of sero-hemorrhagic fluid allowed to escape from under skin flaps. Focus of origin traced down to pocket between intercostal and pectoral muscle layers. Finger introduced in 5th intercostal space, and both internal and external surfaces of pleurotomy wound examined bimanually. There were no adhesions on pleural surfaces, and the pleurotomy scar was solid, pale in color, with silk stitch enclosed in cicatrix. Both lungs and pleural cavities normal.

CASE XVIII.—Operation: *Dorsal pleurotomy, with pneumectomy of left lower lobe.* Result: *Death.* Object: Dorsal thoracotomy evidently successful. Object to try dorsal approach to lung root.

Aug. 15, 1907: Bull terrier bitch (black and white); weight 18 pounds. Technique of thoracotomy the same. Lower left lobe withdrawn from cavity with difficulty, owing to the large presenting posterior surface,

which was with difficulty dragged backward through opening. No gain in extra thoracic approach to root. Lobe could not be withdrawn far enough to apply clamp extra thoracically to the main vessel trunks. This might have been possible through a large pleural opening. Clamp applied one inch from hilum. Lobe amputated. Two large orifices in stump tied separately (probably artery and bronchus). Continuous to stump followed by transfixation and ligature proximal to clamp. Considerable difficulty in closing stump even with two rows of sutures.

Aug. 15: Apathetic. Pulse 160; respirations 36.

Aug. 16: Refuses milk and solid food.

Aug. 17: Temperature 103.4; pulse 150; respirations 48.

Aug. 19: Slight dullness of operated chest. Temperature 103.2; pulse 178; respirations 35. Lying down and lacks energy to shake flies from head and nostrils, from which there is a profuse purulent discharge, somewhat more marked on left side.

Aug. 21: Dullness of left chest approaching flatness. Skin wound clean, dry and flat. Dog placed on board. Etherized. One-half inch of 7th rib excised. Finger introduced. Lung found retracted over all pleural surfaces. Vacuum pump connected with glass funnel, which was placed over wound snug to skin. Probably about six to eight ounces of hemorrhagic purulent fluid sucked into conduit. Water introduced and sucked out again repeatedly. Two drainage tubes inserted and pinned into place. Evidently dog was suffering from general pleuritis of left cavity, although right lung seemed to be doing sufficient work by an increase of respiratory movements. The pneumothorax now produced was no added evil, in so much as the lung was found already retracted and adherent. Mediastinum was also thickened and more stationary.

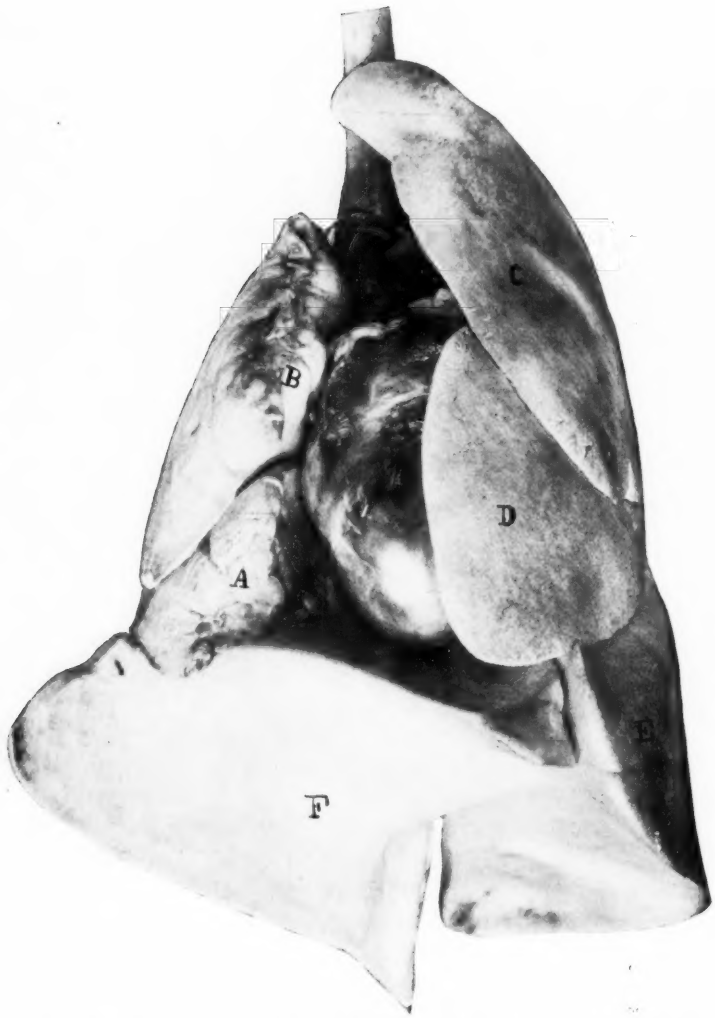
Aug. 24: Dog lived 3 days after drainage, but condition did not improve. Pulse remained over 160, and it was of interest to note that temperature was normal on day of drainage.

Died. Placed in cold storage to await autopsy. By mistake of janitor this animal was destroyed before autopsy. Judging from findings in similar cases, it is probable that the unopened chest was also infected, and death was due to infection of both pleural cavities.

Case XIX.—Operation: *Anterior thoracotomy, excision of right middle lobe.* Result: *Recovery.* Object: Evident that with a larger pleural opening as much can be accomplished extra thoracically by anterior as by posterior approach. It is also possible thus to avoid the difficult skin preparation, the turning over of the animal, the less adapted musculature, and the difficult withdrawal of the lobes, from the base, rather than the apex of a cone, as it were.

An attempt was also made in this experiment to reduce the air-leakage through the pleural opening during the stump suture. The object in this being to, first, reduce the loss of body heat which is ever present in the sucking in and out of outside air into the pleural cavity; second, to lessen also the chance of infectious particles being sucked into the cavity at the same time; third, to diminish the amount of positive pressure necessary to prevent collapse; in other words, to avoid pneu-

CASE XIX.—Excision right middle lobe. (A) Stump.



CASE XX.—Excision of one-half of right upper and middle lobes. (A) Stump of middle lobe. (B) Stump of upper lobe. (C) Left upper lobe. (D) Left middle lobe. (E) Left lower lobe. (F) Diaphragmatic surface of lower lobes.

mothorax as nearly as possible without the help of the apparatus; fourth, to diminish the fluttering tendency of the mediastinum towards the opened side at expiration, and thus to avoid injury to the latter.

Simple packing of gauze around the clamp, owing to the constant movements of the ribs, is not only difficult to maintain, but at the same time permeable. A "stump controller" to be later described served the above purpose admirably, and offered the additional advantage of holding the stump and clamp in fixed position, thus making a more careful approximation of pleural edges in the stump suture.

It was also concluded that picking up and tying of all passages and blood vessels in the stump might, if followed by accurate closure, avoid the necessity of transfixation.

Aug. 20, 1907: Black and white bull-dog; weight 22½ pounds.

Original technique of thoracotomy with excision of 2 inches of 5th rib. Middle lobe drawn out to full traction. Clamp applied. Stump controller applied; gauze packed tight between its under surface and the pleural opening.

Every visible opening in stump snapped and tied with Von Brun linen. Two rows of linen to stump. First row deep; second to pleura only. Clamp released gradually. No oozing or leakage from stump. Wall suture gave satisfactory approximation.

To be noted here that during two-thirds of this operation animal was breathing against only 1–2 cm. of water resistance, as a result of the reduced pleural opening.

Aug. 22: No apparent change in dog's condition. Appears and acts as before operation. Solid food taken ravenously. Temperature 100; pulse 115; respirations 28.

Aug. 25: No change.

Aug. 31: Stitches removed; wound clean and dry.

Sept. 5: No symptoms have developed. Chart has remained normal.

Sept. 30: Dog has developed mange, which causes no symptoms but loss of weight.

Oct. 20: Since last note dog has continued well, with exception of intercurrent mange.

Autopsy, Oct. 20.—Dog killed with ether. One light adhesion between middle lobe stump and pleurotomy wound. Adhesions in immediate vicinity of stump readily separated. Pleural cavities both normal. Lung tissues apparently normal. Lungs and heart excised, inflated and photographed.

Case XX.—Operation: *Anterior excision of one-half upper and middle lobes.* Result: *Recovery.* Object: Satisfied that anterior technique is perfected and necessary in amputation of middle lobe attempted more extensive pneumectomy.

Aug. 25, 1907: Airdale-terrier mongrel. Long hair removed. Increased chance of sepsis from neighborhood of prepared area. Normal method of entrance. Pectoralis cut more tangentially to line of ribs, increasing gridiron arrangement. Middle lobe drawn well out of wound and clamped. Controller applied. Amputation. Bronchus and vessels

in immediate vicinity in stump ligated in single tie. Continuous to and fro linen stump stitch. No transfixation or ligation of stump. Upper lobe withdrawn to half its extent and treated in identical manner. Very slight bloody ooze in region of stumps when dropped back. A tear occurred in first row of pleural stitch, which was closed by second row.

During operation 2–3 cm. (water) pressure sufficient to maintain rhythmical respiration during treatment of stumps. Animal kept light under ether. Time 2 hours. Aug. 26: dog not visited

Aug. 28: Condition excellent. Temperature 102; pulse 126; respirations 35. Hot day accounts for rapid respiration, which is not labored. Prognosis is good. As in question of peritonitis, third day seems to settle prognosis. Dog presents none of serious symptoms which fatalities without exception have manifested on the third day.

Sept. 5th: Prognosis of last note proved correct. Eating well. Active.

Sept. 12th: Stitch, left in as experiment, was not aseptic. Removed.

Oct. 25th: Since last note this dog has been normal in appearance, habits and actions. On several occasions he was heard to give a low cough.

Autopsy (lapse of eight weeks since operation).—Killed with ether. No adhesions at any point between visceral and parietal pleuræ. Light adhesions between stumps of middle and upper lobes. Half of each of these two lobes found lacking. Heart and lungs excised in toto, and frozen. Four weeks later inflated and photographed as in photograph (C).

It will be noted from the above that of 15 cases, including six simple anterior thoracotomies and 9 excisions of portions of lung tissue, Cases I and V were the only fatalities. It is fair to explain these two deaths on the basis of undeveloped asepsis and technique existing at the beginning of this series of operations.

On September first, in view of the low mortality, I had become entirely confident of being able to do simple thoracotomy with surety of recovery. I was sure also of recovery after excision of either upper or middle lobes, or portions of either or both.

Departures from the one-rib-excision technique had not been successful. The only case of lower lobe excision had ended fatally, although it was done by the less perfected posterior approach. The only attempt made in a three-lobe excision had also resulted in death.

The number of recoveries after thoracotomies and moderate excisions convinced me that these fatalities were due

neither to serious influences of the positive pressure method, nor to the existence of pneumothorax at the end of the operation, inasmuch as these factors, had they not been successfully avoided, would likewise have caused death in a majority of the above recoveries. The history of the surgery of the lung reveals rare isolated cases of total extirpation of one normal lung without thoracoplasty with recovery. We also recognize clinically that numerous cases are known to have lived a number of years with only a small portion of the total lung volume remaining functional. It is, therefore, to be presupposed that the above fatalities, and those of extensive resections which may later occur, cannot be explained on the basis of the loss of aerating lung tissue.

As regards sepsis, it must be admitted that in more extensive lung resections there is greater opportunity for infection, because such operations are of longer duration, thus favoring the entrance of sepsis from the normal channels, such as instrumentation, sucking in of infectious air particles, and prolonged exposure of the lung stump. On the other hand, the above sequence of 14 cases (VI–XX) with only three deaths, two of which were the two cases above referred to, that of excision of lower lobe and that of total extirpation, leads me to infer that my aseptic technique is reasonably reliable in animal experimentation, and that the explanation of sepsis in these two cases, and also in those which may later follow of extensive resections, must be found in one of the following factors:

1. The improper closure of the stump with leakage of infectious material.

2. Insufficient closure of stump leading to escape of air, resulting in pneumothorax and collapse, which were not present at the end of operation.

3. Perhaps to the establishment of a definite cavity which may be filled either by granulations or compensatory emphysematous displacement of the remaining lobes.

Case XXI.—Operation: *Excision of right lower lobe.* Result: *Death in three days.* Cause: *Sepsis: pneumothorax from leakage of*

stump. Object: To attempt a series of more extensive lung resections.

Sept. 1st, 1907: Brown and gray mongrel. One rib thoracotomy. Lower lobe withdrawn to limit of traction. Clamp (unprotected) applied extra-thoracic. Amputation. All vessels and bronchioles in stump tied separately. Same used to pick up each vessel in sequence. Attempt then made to concave lung stump with use of thermo-cautery. (Necessary break in asepsis here, after which hands were hastily passed through sterile water and alcohol.) Object of concaving stump was to allow better approximation of pleural edges with possibility of inversion. First row of linen continuous to stump included the latter; a second row of continuous taken deeper and needle was felt to pierce the linen ligatures in the stump. When stump was dropped back after removal of controller, there was a tendency to dyspnœic breathing which was at once relieved by placing palm of hand over wound until normal rhythmical respirations were restored.

Gridiron suture of thorax wall same as in recent cases described. The pleura-intercostal layer was not tight, however, owing to diagonal tears at ends of the wound caused by withdrawal of large lower lobe through an insufficient pleurotomy incision. The pectoral muscle layer, however, seemed to render closure hermetical.

Sept. 2: Chart starts poorly. Temperature 104; pulse 163. Languid.

Sept. 3: Weakness suggested by tottering gait; pulse 170; respirations 38; temperature 102.6; prognosis poor.

Sept. 4: Dog found dead at 9.30 A.M. Died some time during night, but rigor was not well marked.

Autopsy at 11 A.M.—All layers of wall apparently undisturbed. Beginning healing. Three ounces of sero-hemorrhagic fluid in left side. Left lung normal in structure. Right lung upper and middle lobes somewhat atalectatic, and covered with fibrinous exudate. Stump of lower lobe found buried in lymph and fibrin. Suture in place, but pleural edges were everted. On inflation air escaped through an opening in stump $^1/_8$ inch in diameter. When stump suture was removed, stump lay open again to boat-shape produced by cautery. At bottom of boat was an accumulation of pus.

Conclusions.—Septic fibrinous pleurisy. I believe that suppuration came either by introduced bacteria or by infection from the lung stump (which is suggested by the buried pus below the line of suture), which led to sloughing of the stump and liberation of ligated air vessels, and consequent pneumothorax and collapse of lung.

CASE XXII.—Operation: *Excision of three right lobes.* Result: *Death in 5 days.* Cause: *Septic pleurisy; pneumothorax.* Object: To attempt removal of three lobes.

Sept. 2, 1907: Fox-terrier, brown and white; weight 21 pounds. Not known at the time that result of Case XXI was to be fatal. Apparatus fairly satisfactory, but pressure seemed insufficient when pleural opening was unoccupied. Middle lobe amputated as usual, except that boat-shape of stump was this time produced with scissors, previous to tying off vessel openings. Excessive traction on clamp caused lateral

tear in lung tissue proximal to clamp (not closed). Lower lobe clamped transversely to wound, and controller well packed with gauze. Five minutes later, on looking into cavity, air could be seen bubbling through small accumulation of blood around stumps. Leakage evident but trusted to clotting and adhesions to stop it. Upper lobe amputated and concaved with thermo-cautery.

Sponge used to pack off mediastinum removed and found soaked with blood. Mediastinum presented very slight tear. Pleura torn towards axillary rib stump. First row of sutures, however, rendered wound solid. Temperature after operation 96. Afternoon of operation, dog normal and active.

Sept. 3rd: Dressing had been scratched off. Clean one applied. Chart good. Temperature 102; pulse 122; respirations 20.

Sept. 4th: Dog wags tail but disinclined to stand. Took 3 ounces of milk.

Sept. 5th: Condition worse. Languid. Respirations short, more rapid, with slight "grunt" at end of a forced expiration. Temperature 103.6; pulse 150; respirations 38.

Sept. 6th: Respirations more labored. Right chest dull with areas of flatness. Animal placed on board. Opening made through centre of flap. Pus encountered at once under skin with free opening below to pleural cavity. Vacuum pump with funnel attachment applied air-tightly over wound. Hemorrhagic fluid loaded with fibrin sucked away to amount of perhaps six ounces. Meanwhile dog under positive pressure apparatus to aid in the expansion of the sound lung by preventing the deviation of the mediastinum towards the unopened sound chest. Breathing seemed more regular and less labored, with help of this combined positive and negative pressure action. Continued for one-half hour. Drainage tube introduced and stitched close. Gauze dressing and rubber dam superposed with hope of obtaining the suction claimed for the A. T. Cabot empyema dressing. Hair over skin surrounding wound prevented the air-tight approximation of rubber to skin, thus ruining the purpose of the dressing. Swathe applied snugly for 1½ hours. No improvement in condition. Placed on table again. Suction applied 20 minutes; object to support the mediastinum and prevent limited expansion of the sound lung. Then suction and positive pressure both for 1½ hours. Dog considerably weakened by this manipulation. Sat up to ease respiratory movements, but weakness would cause him to fall again.

Sept: 7th: Dog found dead following morning, having been two days in special laboratory cage with flannel blanket covering swathe to increase body heat.

Autopsy.—Very little fluid remaining in right chest. Right lung stump collapsed and covered by homogeneous flat surface of thick fibrinous exudate, which extended from the lung root to the pericardium and mediastinum, making these several structures scarcely distinguishable. On inflating lungs no leakage was detected from any of the three stumps, although it is quite possible that this was prevented by the adherent exudate.

CASE XXIII.—Operation: *Intercostal pleurotomy.* Result: *Recovery.* Object: To test the technique of opening cavity without rib excision, as recommended by Miculicz with use of a rib-spreader.

Sept. 2, 1907: White fox-terrier. Gridiron incision as pictured in drawing II. Spreader used in mastoid operations utilized as shown in drawing III. Ample room thus obtained for excisions. Lung not disturbed. Wall suture in layers.

Sept. 3: Condition excellent.

Sept. 10: No change in condition.

CASE XXIV.—Operation: *Excision of three lobes (right).* Result: *Death.* Cause: *Pleuritic effusion. Collapse of lung.* Object: The fate of Cases XXI and XXII was not concluded when this operation was attempted. Had it been so another lower lobe excision would have been attempted previous to this total extirpation. The main object of the operation was to test the suitability of an intercostal pleurotomy without rib excision, for the extra-thoracic removal of one or all lobes of the lung.

Sept. 3, 1907: Large black and white bitch; weight 20 pounds. The skin incision was made in the form of a long tongue shaped flap with apex near median line over the 5th intercostal space. Muscles and fascia over intercostals divided. Intercostals divided midway in line parallel with curve of ribs. Pleura and intercostal fascia in same line. Ribs then separated by means of a spreader as shown in drawing II. With latter in place, respirations became somewhat labored until pressure was raised to 8 cm. (water). Less was required, however, when opening was occupied by extracted lobes with packing of gauze.

Upper and middle lobes withdrawn, and removed as in the previous operation. Tying of numerous separate openings in stumps was rather unsatisfactory, and the need of an assistant was most evident. Difficulty met in removing lower lobe, not from lack of spread in thorax opening, but rather in deficient length of incision. Resistance to pressure sidetracked in apparatus allowing momentary collapse, and thus enabling easy withdrawal of lower lobe which was clamped as near hilum as possible. The time required for careful treatment of stump was not thought advisable, and a chance was taken on single ligature, with three strands of fine Von Brun linen (a most unsuitable material for such purpose). When stump was dropped back, fresh blood was seen coming from cavity. Inspection of lower lobe stump revealed no leakage, however. Fingers introduced to base of cavity, where blood clots were found. Preferred not to exert traction again on upper stumps, so clotting and absorption were relied upon, inasmuch as there was little possibility that bleeding was from main trunks.

Pleural stitch satisfactory, although it was difficult to pick up the retracted pleura from under the intercostal stumps, as stitch approached completion.

Sept. 4th: Dog apathetic. Hacking cough at times. Chart fairly satisfactory. Temperature 100.6, subnormal; pulse 135; respirations 34.

Sept. 5th: Respiration higher (48). Food taken reluctantly.

Sept. 6th: Lying down. Prognosis poor. Right chest flat to percussion. Respirations 60; temperature 104; pulse 120. No food taken to-day.

Sept. 8th: Entered recovery room to see the dog take last three breaths.

Autopsy 30 minutes later.—Skin wound covered with thin layer of dried blood. Muscle apposition solid, and union commenced. Positive pressure apparatus applied and water sprinkled over wound. There was no bubbling of air through the latter. In removal of right chest wall numerous transparent adhesions were found spanning from parietal pleura to root of lung, namely to the lobe stumps. There were similar bridges to the diaphragm. Right pleural cavity completely filled with hemorrhagic fluid, at bottom of which were no free clots or sediment. (Culture.) This fluid contained no fibrin or pus. and was evidently transudate. Left chest opened. Left lung normal. No blood or fluid in left cavity.

Thoracic contents excised in toto. On examination of remainder of right lung, it was found that all had been removed with exception of a quadrangle shaped fragment, evidently the stump of the upper lobe, which was dark purple in color, but covered by shiny serous coat. The pleural edges had evidently been successfully inverted, but the sub-pleural hemorrhagic condition indicated incomplete tying of vessels in the stump, which may have been responsible for the ooze during remainder of operation. The stump of lower lobe, which had been ligated only, was covered by a dark blood clot. The ligature was in place, and not perceptibly loosened. Under pressure greater than required for the complete inflation of the sound remaining lung, an escape of air was detected at pin point opening in the ligated stump. The heart was apparently not displaced.

Case XXV.—Operation: *Excision of right lower lobe.* Result: *Death.* Object: Removal of upper lobes has been succesful. Removal of all lobes has been fatal. Question arose then whether the removal of lower lobe was responsible for death.

Sept. 10, 1907: Fox-terrier; bull-terrier mongrel. Right intercostal pleurotomy. Spreader introduced. Lower lobe clamped and amputated. Stump concaved. Vessels and bronchioles tied with especial care. Braided pedicle silk then placed proximal to clamp and drawn tight. At this moment a joint in a rubber tubing air conduit parted before second knot of ligature was taken. Stump dropped back, and gauze stuffed into wound. Respirations immediately became labored and intermittent. Tubing repaired with difficulty, but in time to prevent death. Stump withdrawn again for second knot in ligature. Wall sutures applied as usual. Rectal temperature at end of operation, below 96.

Sept. 10, 11 A.M.: Dog found dead; still warm. *Autopsy* one hour later. Wall sutures solid and clean. Right chest was half full of serohemorrhagic fluid (culture on blood-serum). Lower lobe found to have three lobules, one of which only was removed. Adhesions between stump and diaphragm. Lower lobe stump bulging at centre, but there was no

leakage under inflation. All remaining lobes of right lung normal. No atalectatic areas. Left lung normal. No fluid in left chest.

Cases XIII, XVIII, XXI, XXIV and XXV constitute a group of fatalities which should be considered together. In three of these cases a lower lobe was removed. In three other all of the right lobes were removed. What was the cause of death in these cases? I am tempted, at the outset, to exclude the use of positive pressure apparatus as the cause of fatality, and to credit deaths to the existence of a permanent cavity remaining in the right chest after operation. Even in the presence of sepsis, which existed without question in three of these cases, the principal cause of death was undoubtedly the effect of the presence of a cavity in which the air pressure did not equalize that of the unopened side of the chest. Such a difference must necessarily lead to the deviation of the mediastinum towards the remaining lung during inspiration and away from it at expiration. Such movements must hamper the excursion of the remaining lung, and restrict its oxygenation. The persistence of this undoubtedly causes circulatory disturbances by its effect on the right heart. Just what these disturbances are will be discussed in a later paper. The postmortem cultures taken in these cases were not under strictly aseptic precautions, and I have excluded them in the case reports. The operations were done under the same aseptic procedures. The increased possibility of sepsis caused by the increased length of operation, and added exposure of the lung stumps, are not sufficiently important factors to explain the cause of death in this group of cases, especially since the previous operations, with one or two exceptions, were absolutetly free from pleural infection.

With a further desire to practically test this question, renewed efforts were made to exclude all chances of infection, and to rule out any possibility of leakage through the lung stumps which will of course produce pneumothorax, with resulting compression of the sound lung.

PHOTOGRAPH A.—Positive pressure apparatus.

DESCRIPTION OF APPARATUS.

The glass cone (N), with a rubber drum over the base is placed over dog's face, the drum causing air-tight closure just forward over the eyes. Thus any possibility of constriction around the neck is avoided. The cone is held in position by side straps, as shown in photograph. Compressed air enters the apparatus at A. With pet-cock B opened and cock C closed, manometer P is read. Experience teaches how much pressure with vent B open is suitable before leading air through apparatus. Cock C is now opened, and B closed. Air passes along conduit X, X, X. With cocks adjusted as in photograph, air passes through D into ether bottle, E, and out again through G. By pipes I, I, I, it enters cone and at inspiration passes into lungs. Dog's snout fills up most of cone, so that small dead space exists and exhaled air passes immediately through efferent conduit K, K, K to water column H. By raising or lowering clamp R on upright rod, the resistance to pressure is varied. Such resistance is indicated in water manometer L and mercury manometer M. Previous to pleurotomy pressure may be avoided without shutting off or side-tracking air compression by opening cock, which allows almost immediate exhaust to exhaled air. Through cock to the vacuum the resistance is recorded through glass conduit to foot of table, where it connects with tambour and is recorded on revolving drum. Tubing (W) is connected with oxygen tank, which on closure of cocks F and G substitutes oxygen for compressed air and manometer M gives reading of oxygen pressure.

From reservoir O, ether may be added at any time to bottle E, with cock F open and D and G closed.

If more air is desired for dilution of ether-vapor, cocks F, D and G are left open. If air alone is desired F is left open, and D and G closed. At point J may be seen piece of rubber tubing slipped over cock such as are boiled with instruments and placed over cocks B, C, F, G, D, and J just previous to incision, so that operator can control apparatus without breaking asepsis.

CASE XXVI.—Operation: *Excision right lower lobe.* Result: *Recovery.* Object: With renewed possibility of asepsis of perfected apparatus, another lower lobe excision attempted.

Sept. 15, 1907: Black pointed nose mongrel; weight 25 pounds. Long tongue shaped skin flap with apex one inch from median line, base in axilla. Fifth intercostal space incised three inches. Lower lobe readily withdrawn through this increased opening. Technique improved by use of Doyen clamp, with blades protected with rubber tubing (see drawing IV). With this long clamp transverse to ribs, with gauze packing around stump, immobilization was accomplished without use of stump-controller. Stump treated with greatest possible care. Concaved to boat shape. All vessels searched out and tied. New technique of closure employed as described in drawing (V). Inversion of pleural edges by the Lembert suture most satisfactory. In every previous case lung tissue has presented along suture line between stitches. Stump dropped back, with no oozing of stump on removal of clamp. In pleuro-

intercostal continuous linen stitch, all turns were taken before any one was drawn tight, thus allowing the natural gaping of the wound to persist until needle work was complete. In this way pleural edges could be clearly seen and picked up at each turn. Two sutures were used, each beginning at either end of wound and working toward the centre. When placed the turns of one stitch were taken up consecutively, and tied. Those of the second stitch were similarly taken up, beginning at the end of the wound and working towards the centre. The latter stitch was not tied until an excessive resistance to pressure had been applied at end of expiration, thus evacuating as much air as possible from the pleural cavity before final closure was secured. No vessels in the thoracic wall were tied in this case. Continuous over and over linen stitch to skin. Quick recovery from ether, with no respiratory disturbances.

Sept. 16: Somewhat subdued, but wagging tail and able to jump down from bench. Temperature 101.6; pulse 140; respirations 30–40.

Sept. 17: Respirations panting, due to heat of day.

Sept. 20: Accumulation of fluid under skin flap led me to fear that there was connection with pleuritic effusion. Chest aspirated in axillary line, and suction employed, but no fluid was obtained. It was evident that motion had occurred between muscle layers, allowing, as in all such cases, an accumulation of fluid outside the fascia. This was allowed to escape from under the flap.

Sept. 24: Dog entirely well. Stitches all out. Active and eating well. Shows no evidence of operation.

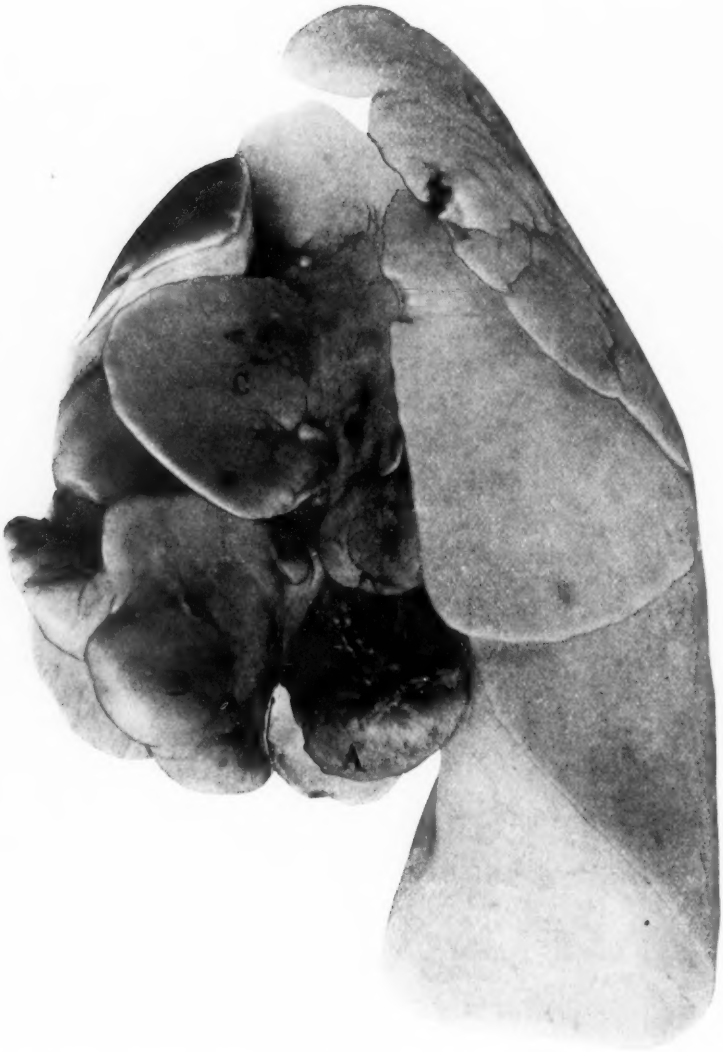
Oct. 25: Well since last note. No symptoms. Has gained about 4 pounds in weight.

Autopsy, Nov. 13, 1907.—Dog entirely well. Killed with ether. Pleural cavity opened in 6th space. Finger introduced for palpation of pleural surface of original thoracotomy wound. There were no adhesions, and the line of pleurotomy could not be distinguished owing to its serous covering. Lungs and heart removed in toto. Right chest wall removed. There were no adhesions between visceral and parietal pleuræ at any point. Both pleural cavities fluid free, and normal in appearance. Heart not displaced. Lungs and heart removed in toto and inflated with apparatus, a cut being allowed in conduit regulated to keep lung at a given stage of inflation. The lung tissue appeared to be normal throughout. Numerous easily separated adhesions between lower lobe stump and adjacent surfaces of middle lobe and mediastinal or "butterfly" lobe. The middle lobe as a result of these adhesions had assumed a cabbage-like appearance. (See Photograph E.)

Case XXVII.—Operation: *Pleurotomy. Clamping and release of right lower lobe.* Result: *Recovery.* Object: Apparent good progress of Case XXV encouraged me to attempt second lower lobe excision with new apparatus.

Sept. 16, 1907: Boston terrier—bull terrier mongrel; weight 26 pounds. All sterile arrangements completed when ether cone slipped from its attachment. Asepsis broken in reapplication, also possibility of infection of sterile rubber protection tubing on two of valve cocks.

CASE XXVI a.—Excision right lower lobe. (A) Stump. (B) Right middle lobe.



CASE XXVI b.—Excision right lower lobe, (A) Stump. (C) Mediastinal lobe turned upwards. (B) Right middle lobe.

Laparotomy sheet slid downwards during these manœuvres, and incision was consequently made by mistake in seventh intercostal space. Soon evident that withdrawal of lower lobe would be difficult through this space. Under full traction only about three-fourths of lobe could be withdrawn, necessitating a large stump which would be difficult to close tight. Rather than run the risk of a mortality under these conditions, the "stomach-clamp" which had been applied was, after five minutes' application, removed. Considerable manipulation of the lung had thus occurred. At one moment of manipulation pulse beats suddenly became very slow, and respiration nearly ceased. When lobe was released, both functions were restored to normal without change in pressure. This was doubtless due to irritation of vagus terminals. (See changes at this stage of operation in tracing. In spite of considerable trauma to lower lobe, after which hemorrhagic areas were apparent as well as small atalectatic areas, I concluded to attempt recovery in this case, thus to test the resistance of normal lung tissue to such manipulation. Thorax wall sutured in layers, as in Case XXV. Time one hour.

Sept. 17, 1907: Dog as lively as before operation. Showed no signs or symptoms of any sort. Temperature 102; pulse 140; respirations 24.

Sept. 18: Temperature 102; pulse 92; respirations 20.

Sept. 20: Dressing removed. Wound clean and dry. Chart and notes omitted.

Nov. 15: There has been no interruption to normal convalescence.

Autopsy.—Dog killed with ether. The thorax well showed strong cicatrization of all layers which were adherent to one another. There was no fluid in either pleural cavity. There was one small light adhesion between the inferior surface of the right lower lobe, and the diaphragm. The contour of the right lower lobe was normal throughout. There were no hemorrhagic, emphysematous, or atalectatic areas at any point, and the parenchyma presented a normal homogenous pink coloration. In other words, there was no evidence that the lower lobe had ever been under clamp compression.

Case XXVIII.—Operation: *Total excision of right lower lobe.* Result: *Recovery.* Object: To further test the effect of pneumectomy of a lower lobe.

Sept. 20, 1907: Fox-terrier (brindle spots); weight 18 pounds. Technique of this operation was identical with that of Case XXV. Visceral pleura incised annularly ½ inch from clamp, and attempt made to roll it back to form a pleural cuff. This was partially successful, although pleura, being incorporated in lung parenchyma, required some dissection for its separation. Two rows of inverting Lembert sutures were thus easily and successfully taken.

This operation was most satisfactory in that each step of the technique was successfully carried out, and the mechanism of the new apparatus was excellent.

Sept. 21: Dog languid and not inclined to eat. Prognosis poor.

Sept. 22: Temperature 103.6; pulse 170; respirations 60. Dog seemed "sick unto death." Pleuritic effusion feared. Chest aspirated in axillary line, 7th space. No fluid obtained.

Sept. 23: No improvement, except in respirations (48). Refused food. Characteristic hitch at end of short expiration present in previous fatal cases.

Sept. 24: Able to hop down from bench. No food taken. Drainage had been so unsuccessful in above fatalities that I preferred to wait. The following day dog began gradually to take a turn for the better. Food taken with considerable hand-to-mouth coaxing. Dog walking about and looking better.

Sept. 27: Temperature 103.6; pulse 160; respirations 30. Wound clean and dry.

Sept. 30: Temperature 102.4; pulse 110; respirations 22. Dog much improved. Peculiar action of hind legs noted. Dog cannot jump without falling. Apparent weakness beyond lumbar spine. Hind legs cross in walking, and a tottering gait is noted.

Oct. 25: Dog has gained weight and eats well. Spastic action of hips and legs persists.

Nov. 10: There is a slight kyphosis in lumbar region, and a deep skin ulceration in same region one-half inch from vertebral column.

Autopsy, Nov. 13, 1907.—General condition excellent. Dog etherized Anterior neck dissected and trachea freed. Trachea clamped at end of inspiration and cut. Object of this was to determine the exact size and condition of the cavity left by lower lobe excision previous to post-mortem collapse of lungs.

Portion of lower right chest wall removed. Remaining lobes of right lung found in close apposition to parietes, indicating normal inflation. Vacated space was not filled by compensatory dilation of remaining lobes, nor by heart displacement, nor by an accumulation of fluid. Unlike Case XXV, however, the space was about half filled with peculiar looking material resembling lymph in texture, but of a reddish color. It seemed to arise from all pleural surfaces which bounded the space previously occupied by the lower lobe. With a finger it could be wiped away from these surfaces without difficulty.

Lungs and heart excised in toto. Stump of lower lobe firmly adherent to diaphragm, middle lobe, mediastinal lobe and pericardium. These adhesions were freed with some difficulty.

Tissue examined by Wolbach proves to be free granulations.

Case XXIX.—Operation: *Imitation of an exploratory operation for tuberculosis, with removal of two isolated foci.* Result: *Recovery.* Object: While watching prognosis of Cases XXVI and XXVIII to do a less radical operation.

Sept. 22, 1907: Large black bull mongrel; weight 26 pounds. Incision triangular in shape, with apex towards median line. Apparatus satisfactory throughout operation. Found it advantageous to increase pressure more by added influx of compressed air and less by sinking glass tube in water column. In other words, increased compression with

CASE XXVIII.—Excision of right lower lobe. (A) Stump. (B) Right middle lobe. (C) Left lower lobe. (H) Heart.

CASE XXX.—Excision of right upper and middle lobes. (A) Stump of middle lobe. (B) Stump of upper lobe. (C) Mediastine on butterfly lobe.

diminished resistance resulting in the same manometer readings as in the reversed conditions.

Right upper lobe withdrawn and handled roughly. Doyen clamp applied two inches distal to root extra-thoracic. An oval shaped fragment the size of an almond was then excised from internal surface of lobe. Three ties taken in wound thus made. Bared surfaces approximated with linen and an inverting of pleural surfaces accomplished. Middle lobe then withdrawn and clamped. A triangular shaped piece with sides 1½ inches long then amputated from the tongue of this lobe. Usual treatment of stump. Lower lobe not disturbed.

Sept. 23: Dog very lively, as before operation. Solid food at once.

Oct. 14: There has been no change in this dog's condition. He has gained weight, and is active as usual.

Dec. 8: Dog has been a good laboratory animal, and has been kept for physiological tracings during autopsy.

CASE XXX.—Operation: *Amputation of upper and middle lobes (right)*. Result: *Recovery*. Object: To repeat an amputation of upper and middle lobe as in Case XX, where, as will be seen in photograph, scarcely more than half of these lobes had been amputated. With new intercostal technique and use of spreader, more complete pneumectomy could undoubtedly be performed.

Sept. 27, 1907: Black pointed-nose mongrel. Usual technique of last few cases with new apparatus employed. The advantages of the new apparatus are most gratifying. The control is simple, the conduits are wide, the connections are solid, and I am entirely satisfied of its practicability.

Sept. 28: Very slight languor. Solid food taken day after operation.

Sept. 30: Normal chart: Temperature 102.2; pulse 75; respirations 20.

Nov. 20: This dog's convalescence has been absolutely uninterrupted.

Autopsy.—Dog killed with ether. No fluid in either cavity. Microscopically parenchyma of both lungs normal. Stumps of middle and upper lobes adherent to one another, with adhesion also to upper surface of lower lobe. These adhesions were freed, and the lungs and heart excised and photographed.

Pieces of lung stumps placed in Zencke's fluid for later section by Wolbach to determine nature of repair.

SUMMARY OF THE ABOVE THIRTY CASES.

CASE I.	Pleurotomy. Death, 4th day.
CASE II.	Application of positive pressure. Recovery.
CASE III.	Pleurotomy: one rib excised. Recovery: localized empyema.
CASE IV.	Pleurotomy: one rib excised. Recovery.
CASE V.	Excision: portion middle lobe. Death, 6th day.
CASE VI.	Pleurotomy: one rib excised. Recovery.

Case VII.	Pleurotomy: one rib excised. Recovery.
Case VIII.	Pleurotomy: two ribs excised. Recovery: empyema.
Case IX.	Excision: tip of middle lobe. Recovery.
Case X.	Excision: one-third of upper lobe. Recovery.
Case XI.	Excision: one-half upper lobe. Recovery.
Case XII.	Excision: two-thirds middle lobe. Recovery.
Case XIII.	Excision: three right lobes. Death, 5th day.
Case XIV.	Pleurotomy: three-rib-flap. Death, 3rd day.
Case XV.	Excision: three-fourths middle lobe. Recovery.
Case XVI.	Excision: three-fourths middle lobe. Recovery.
Case XVII.	Dorsal pleurotomy. Recovery.
Case XVIII.	Dorsal excision left lower lobe. Death, 9th day.
Case XIX.	Excision middle lobe. Recovery.
Case XX.	Excision one-half upper and middle lobes. Recovery.
Case XXI.	Excision right lower lobe. Death, 3rd day.
Case XXII.	Excision three right lobes. Death, 5th day.
Case XXIII.	Intercostal pleurotomy without rib excision. Recovery.
Case XXIV.	Excision three right lobes. Death, 3rd day.
Case XXV.	Excision right lower lobe. Death, 2nd day.
Case XXVI.	Excision right lower lobe. Recovery.
Case XXVII.	Clamp and release of lower lobe. Recovery.
Case XXVIII.	Excision right lower lobe. Recovery.
Case XXIX.	Excision portions of upper and middle lobes. Recovery.
Case XXX.	Total excision upper and middle lobes. Recovery.
	Total: 9 deaths; 21 recoveries.

Conclusions.—I think I am not mistaken in stating that the foregoing shows a lower death rate in experimental operations on the lungs and pleura than has hitherto been reported.

From this practical test of the suitability of the positive pressure method of inflation for intra-thoracic surgical procedures, I am convinced that, at least for experimental laboratory work, a positive pressure apparatus such as I recommended in photograph D entirely obviates the necessity of the negative pressure cabinet. I refer not to physiological experimentation alone, but to laboratory operations on the thorax in which recovery is desired. In the above enumerated cases, I do not ascribe a single death to the use of positive inflation as such. Neither do I recognize symptoms after operation which can be justly attributed to the use of positive pressure.

It remains for me to further justify the reliability of this method by making blood pressure tracings of the pul-

monary and aortic systems to test whether, under proper control of the apparatus disturbances in these factors are any greater than those resulting from the negative pressure method. By further investigation I hope also to determine the absolute cause of pleuritic effusion and death following total one-sided pneumectomy, and to test different methods of thoracoplasty, including artificially produced mediastinal and diaphragmatic herniæ, with the object of at least partially obliterating the unoccupied cavity. I recognize that successful total pneumectomies of normal animal lungs without thoracoplasty have been claimed, but such cases are extremely rare and I question whether such procedure will ever become a reliable one.

As a matter of fact, total extirpation of a lung would rarely be occasioned in the human except in cases of new growth, wherein the chest wall would ordinarily be involved and a thoracoplasty would be the operation of choice.

It is conceivable, then, that a large majority of deaths in the above series were caused by operative procedures which are never indicated, and under such normal conditions as are never present. Should we exclude these fatalities then, granting that the apparatus was not responsible, there is reason for encouragement from these experiments that for partial lobe excision, for exploratory operations, and for removal of foreign bodies, we have a reliable method which is not attended by the inconveniences and expense of a negative pressure cabinet. Nor has it been proved, though stated, that interlobular abscesses and other localized inflammatory conditions of the pleural cavity may not be approached through regions uninvolved, brought to the wound, walled off and drained, as in intra-abdominal operations.

In closing I will call attention again to the eight objections raised by Sauerbruch in his publication of 1904, and attempt to answer them.

1. The change in method of breathing.

Sauerbruch refers here to the method of rhythmically inflating the lungs, regardless of the normal reflex mechanism

of respiration. It is evident in the use of such an apparatus as this, and that described by Brauer, that the animal continues to breathe in normal fashion, but is assisted in so doing by air compression which prevents lung collapse.

2. Interstitial emphysema of the lung as a result of artificial in-pumping of air.

It may be stated that in the above thirty cases no evidence of emphysema have been recognized macroscopically. It is probable that the microscopic sections will show localized emphysema in the region of the lung stumps. A great effort has been made to prevent distention of the lung beyond its normal limits, and when such conditions are maintained there is no apparent reason for the development of emphysema.

3. The effect on the circulation.

I have made no observations on pulmonary blood pressure during the existence of positive pressure. I believe, however, that if the resistance to the lung is not carried to excess that the normal relations between the general and pulmonary pressures will be little disturbed. I add one of a series of tracings which I have made to show the comparatively slight respiratory and circulatory disturbances which occur in the course of such operations as the above under positive pressure.

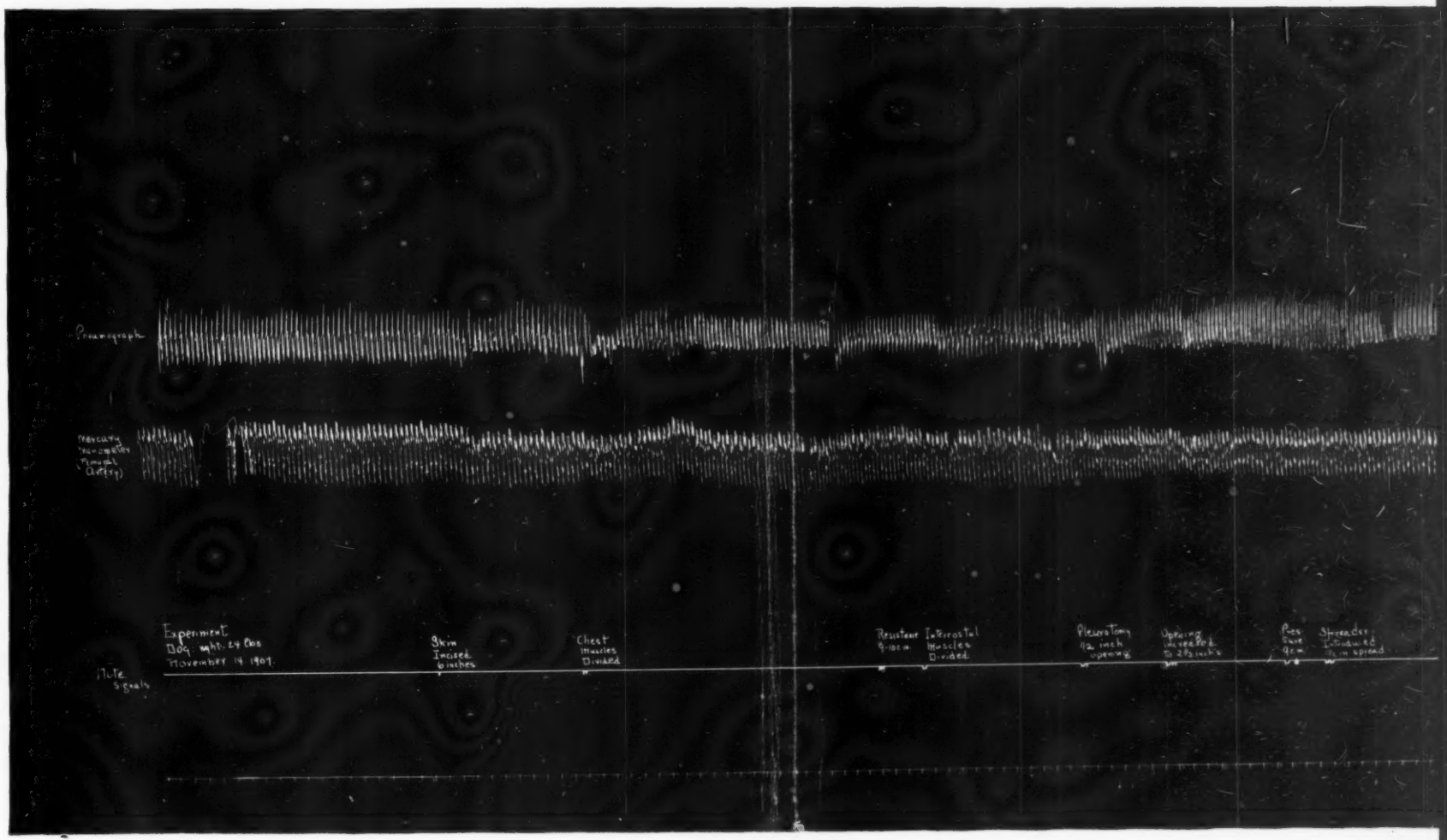
4. The persistence of pneumothorax at the abandonment of artificial inflation.

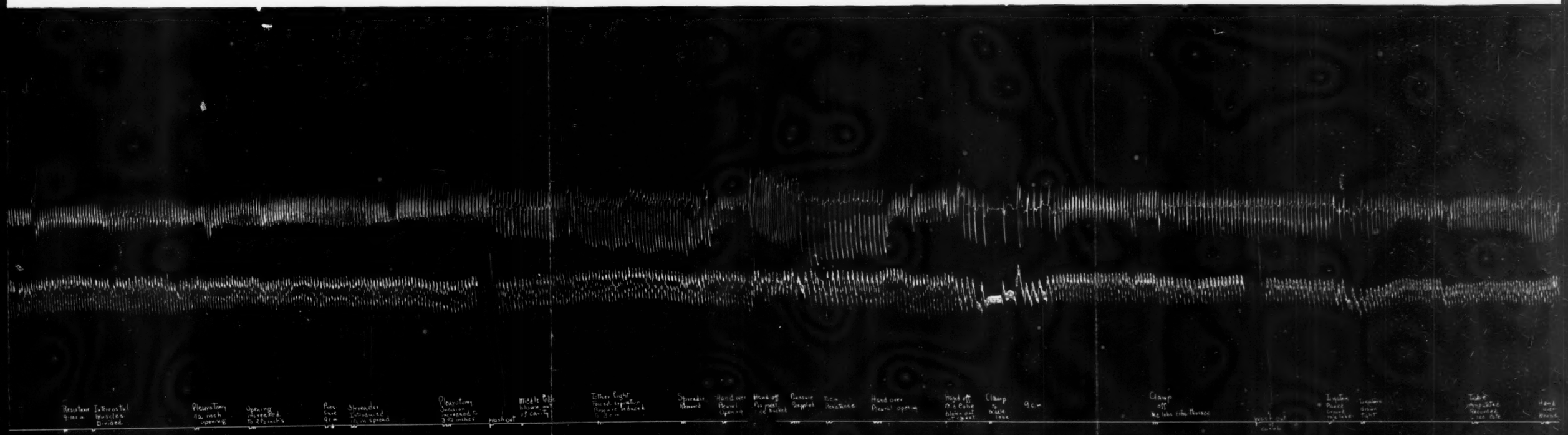
By the maintenance of the positive pressure until the thoracotomy wound is closed, exaggerated a trifle as the last pleural stitch is tied, it has, as the results indicate, been possible to avoid the persistence of a pneumothorax.

5. The great loss of heat.

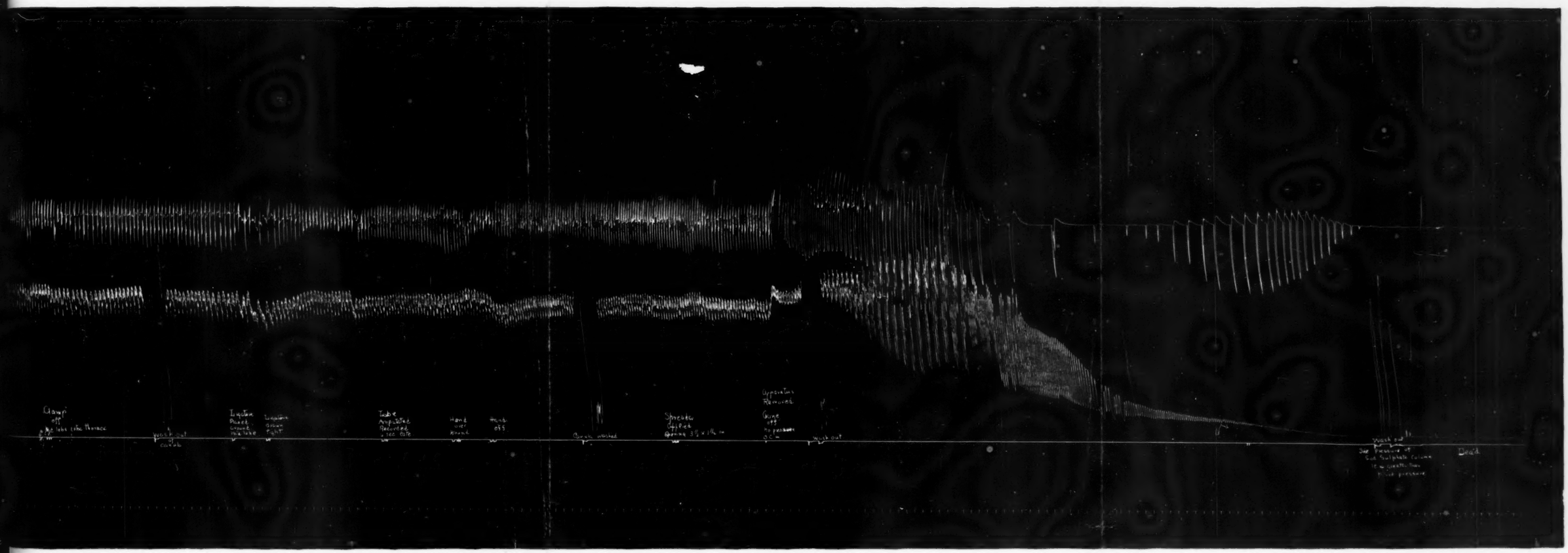
This factor must be admitted, as seen by the above records. The temperature of a cabinet is high by necessity, although that of an operating room also might be so rendered. Nor do I credit any of the above fatalities to this loss of heat.

6. The great danger of infection to the pleura as a result of the extensive air exchange in the pleural cavity.


Pneumograph
Mercury manometer (Femoral Artery)
Experiment
Dog wht. 24 lbs
November 14 1907.
Skin Incised 6 inches
Chest Muscles Divided
Resistance 9-10 cm
Intercostal Muscles Divided
Pleura Torn 1/2 inch opening
Opening Increased to 2½ inches
Pneumothorax
Tracheotomy
Note Signals



Kymograph tracing during experiment under positive pressure apparatus to show comparative slight changes in aortic blood pressure and respiratory curves, during maintenance of



changes in aortic blood pressure and respiratory curves, during maintenance of pressure.

This danger is doubtless present. If infectious organisms are in the vicinity, however, it would seem difficult to exclude them from a pneumatic chamber.

7. The necessity of tracheotomy.

This is obviated by the use of an air tight mask, as shown in photograph. In this a great advantage can be claimed over many of the well-known respiratory devices in which tracheotomy is necessary.

8. The difficulty of narcosis.

This difficulty has not been experienced in the application of this apparatus. The animals have been evenly anesthetized, and none have been lost from over-etherization.

I gratefully acknowledge the assistance and encouragement given to me in this investigation by Prof. Walter B. Cannon of the Physiological Department. Through his courtesy and help I have become familiar with the use of physiological apparatus and technique which have enabled me to make certain observations along the lines of pathological physiology which will be reported in a second paper.

For reports and consultation in connection with the pathological aspects my thanks are due to S. B. Wolbach of the Pathological Department.

The apparatus and new instruments were executed by H. M. Webber, mechanic at the Harvard Medical School.

SHOULD CHOLECYSTITIS AND CHOLELITHIASIS BE ANY LONGER CONSIDERED MEDICAL AFFECTIONS, AND WHAT ARE THE USUAL CONSEQUENCES OF SO TREATING THEM?*

BY CHARLES B. G. DE NANCREDE, M.D.,

OF ANN ARBOR, MICH.,

Professor of Surgery in the University of Michigan and in Dartmouth Medical College.

My attention was recently called to the views apparently held concerning cholecystitis and gall-stones by the rank and file of the profession, by a remark of my chief of clinic, "that the general profession at present seems to occupy the same position towards biliary surgery that it did ten years ago towards appendicitis." I am satisfied that this is largely true, and that the real importance of certain biliary conditions and the impossibility of successfully dealing with them otherwise than by the knife, is not widely enough recognized. The idea is certainly too prevalent in the profession that to warrant a diagnosis of cholecystitis some jaundice should be present, and that a painful, tender tumor in the region of the gall-bladder should be demonstrable with possibly chill, but certainly marked fever, while the failure to detect jaundice seems to many, unavowedly, to unsettle their tentative diagnosis as to the possibility of cholecystitis. If asked, point blank, whether uncomplicated inflammation of the gall-bladder could produce jaundice, the majority would answer correctly, no, but practically the absence of this symptom staggers them.

My first postulate is that cholecystitis is an infective process which precedes the formation of calculi, and that either with or without stone formation this disease of the gall-bladder implies certain potential dangers. It is true that the most common form of cholecystitis is produced by germs

* Read before the Rochester Academy of Medicine, May 3, 1907.

of low virulence, but what warrant exists for the belief that secondary infection with virulent organisms will not take place, causing infectious cholangeitis—often a most fatal condition—or suppuration or gangrene of the gall-bladder with fatal peritonitis? What certainty is there that crippling adhesions involving the stomach and intestines will not form with persistent ill health, or even hopeless gastric dilatation? The absence of gall-stones at an operation in chronic cholecystitis does not prove that none have been passed or preclude the probability of their new formation. Let me illustrate my contentions by reading the notes of a few cases.

1. Mrs. F., age 76 years. A few days previous to entrance to the University of Michigan Hospital had chills followed by high fever and severe pain in the right hypochondriac region. She claimed never to have had any biliary trouble and believed this to be her first attack. Operation revealed a ruptured gall-bladder with old inflammatory trouble. Five days later a single, non-faceted stone was removed from the cavity formed among the adherent bowels.

2. Mr. G., age 72 years. Had never recognized pain or fever and had never vomited; very slight jaundice was present. Operation revealed suppurative cholecystitis with stones blocking the cystic duct.

3. Mrs. C., age 48 years. Vomiting, pain radiating to right shoulder, chills, fever and clay-colored stools were noted. Operation showed old adhesions around gall-bladder and common duct; no stones; cure followed loosening of adhesions and drainage.

4. Mrs. D., age 41 years. Severe jaundice, no vomiting, chills or fever, pain described as intestinal cramping, marked diarrhœa. At operation gall-bladder much distended, no stones. Cholecystitis with cholangeitis causing jaundice.

5. Mr. X., age 47 years, rapidly developed after an attack of ptomaine poisoning gastric and hepatic pain, irregular attacks of chills, fever and sweating, acholic stools, intense jaundice, and rapid loss of flesh and strength. An obscure thickening in the region of the pancreas was detected. The family physician's

diagnosis was not concurred in of common duct stone, but infective cholangeitis was believed to be present. His condition forbade operation.

Post-mortem.—General suppuration cholangeitis was found with obstruction of the common duct from some undetermined condition of the pancreas. Early hepatic drainage would have saved this patient.

6. Mr. M., age 56 years, had gradually developed severe jaundice, commencing about seven weeks before admission to the hospital. Neither pain, vomiting, chills, clay-colored stools nor stones in the stools were noted. Operation showed gall-bladder containing a pint of bile, cystic duct kinked by weight; no stones, ante- or post-mortem, the patient dying from hemorrhage in thirty-six hours, having hematesis, bloody stools and free bleeding from the gall-bladder. This case must have had long standing cholecystitis, judging from the conditions found.

Disease of the gall-bladder was present in all the cases quoted. No extended argument is needed beyond the histories of these patients to demonstrate that cholecystitis with or without stone may present few of the ordinary symptoms expected, that it may prove a menace to life when least suspected, and that the symptoms in some instances closely simulate those of common duct stone, while suppurative and gangrenous cholangeitis is seen to be a most dangerous condition which may develop at any time from a chronic cholangeitis.

Although the natural resistance of the hepatic and somatic tissues may prevent the most dangerous complications related, or even gain the victory so far as life is concerned, if the assistance of art is invoked, it must be admitted that these conditions of the gall-tracts can only be efficiently dealt with by proper operative intervention, and that early hepatic drainage will often prevent a lifetime of invalidism, or avert death. Moreover, the deteriorating effects of chronic jaundice, cholemia, and infection account for those unrestrainable capillary hemorrhages that not uncommonly destroy life after otherwise successful operations. Listen to these notes.

7. Mrs. P., age 50 years. Had been deeply jaundiced for many months past. The stools had been clay-colored since the commencement of the jaundice, except when tar-colored from altered blood. Patient had frequent epistaxis, and there were areas of subcutaneous hemorrhage. At operation one stone was removed from the common duct and one from the gall-bladder. Death resulted from steady capillary hemorrhage in thirty-six hours.

8. Mrs. C., age 28 years. Had had attacks of pain for the past seven weeks, located in the liver region, but radiating to the epigastrium. Slight jaundice with repeated chills and fever were noted. Numerous old adhesions were found at operation; the pancreas was two or three times its normal volume. A single loose stone was found in the gall-bladder. On the third day the drainage from the gall-bladder was largely blood and quantities of it soaked the dressings. The hemoglobin and number of red cells rapidly diminished, every evidence of severe loss of blood with profound shock being present. After the seventh day the hemorrhage ceased and the patient recovered; here the presence of old adhesions proved that chronic cholecystitis had been overlooked, and that the nearly fatal hemorrhage resulting from the acute jaundice due to cholangeitis could have been averted by timely hepatic drainage.

9. Mrs. B., age 55 years. Severe jaundice of long standing was present. No chills, fever or pain. At operation, malignant disease encircling the common duct with liver secondaries was found. Severe hemorrhage took place from the wound on the second day, but this finally ceased and the patient recovered.

Case 6, as you recall, also died after profuse bleeding. Are not these cases adequate proof of the dangers of hemorrhage after chronic cholemia and jaundice?

The tendency to serious capillary hemorrhage usually occurs only in cases of pronounced and prolonged jaundice and cholemia, but an undetected, mild grade of cholemia preceding a comparatively short and slight jaundice may provide the necessary conditions, as exemplified by Case 8.

The constant presence of bile salts in the blood vessels leads to such destruction of the red cells that an impov-

erished, imperfectly elaborated pabulum is supplied to the minute vessels, while at the same time these salts attack and compromise the integrity of their intimal coat, of which, indeed the capillaries are alone formed.

An answer to the question "what causes jaundice in hepatic ailments" will clarify our ideas. Obstruction of the common duct will compel back pressure and resorption. Adhesions; pressure from without by a tumor; or inflammation of the pancreas; distortion or narrowing of the duct orifice by traction on the duodenum (as is sometimes caused by a loose kidney) can produce choledoch obstructive jaundice as well as a calculus. Infective cholangeitis causes obstruction of the intra-hepatic ducts from swelling of their lining membrane, interfering with or arresting the exit of bile, thus favoring its resorption. When the jaundice is not due to common duct obstruction it can only be produced in this way, if we except a hematogenous origin. Thus the presence or absence of jaundice in cholecystitis, cystic duct kinks or obstruction of this by adhesions, gall-stones or cystic duct stones is explicable, as well as the absence or presence of acholic stools, because the jaundice is due to a complicating cholangitis, and not directly to any of the conditions mentioned. Again, the illusory improvement occasionally seen in carcinoma of the liver, from lessening or disappearance of the jaundice, simply means a lessening or complete subsidence of the swelling of the intra-hepatic duct linings, not to a change in the carcinomatous disease.

A rather blind acceptance of the group of symptoms supposed to indicate the presence and passage of gall-stones is too prevalent in the profession, viz., pain starting in the right hypochondrium radiating to the back and preferably to the right shoulder; violent vomiting; a sudden cessation of the pain; jaundice; clay-colored stools; and calculi to be found in the stools, if careful enough search is made. Again, many practitioners, having seen chills, fever and sweating with marked jaundice and acholic stools in some cases of common duct obstruction expect to find it in all such cases,

and are also surprised when no common duct obstruction is found after such symptoms. Still further, jaundice means with many as a complement, acholic stools, and when the latter are absent, doubt arises as to any gall tract disease being present.

A moment's reflection upon certain anatomical facts should modify any such views. Why should there be jaundice even if the cystic duct is blocked by a stone, if the common duct is patent? There is no reason, unless cholangeitis be present, which in a certain number of cases of cholecystitis and cholelithiasis does obtain, because organisms of more than usual virulence are being excreted with the bile and set up inflammation in the intra-hepatic ducts.

Why should gall-bladder disease be accompanied by chills followed by fever and sweats, unless suppurative or gangrenous cholecystitis is present? Certainly no reason exists. Excluding these two conditions why should aguish attacks and acholic stools be viewed as produced only by an occluding choledoch stone, instead of being mere evidences of common duct obstruction by adhesions, tumor pressure, kinking from over-distension of the gall-bladder, or enlargement or disease of the pancreas. Fever, chills, and sweats occur because the lymphatic and vascular arrangement of the common duct favors a rapid absorption of infective products; while, if the cystic duct be blocked, absorption is slow and difficult on account of the scanty lymphatic network of the gall-bladder.

As instances of the uncertainty of the significance of jaundice other than as a symptom of cholangeitis, and because these cases present other features of interest, let me run over abstracts of the histories of a score or more of cases, asking you to bear in mind the points emphasized in the cases previously mentioned.

10. Female, age 47 years.—Had typhoid fever when a child. Vomits during attacks; pain in right hypochondrium which extends up to the right shoulder; slight jaundice present;

no chills or fever; stools normal; no stones detected in stools; calculi found in gall-bladder.

11. Woman, age 47 years. Had typhoid fever as a child; vomiting during attacks following sharp pain in epigastrium; no jaundice; stools normal; no stones were found; calculus in cystic duct.

12. Man, age 46 years. Had typhoid fever ten years previous to commencement of present trouble which is of a number of years duration. Vomiting lasts from one to twelve hours in each attack; pain referred to epigastrium; continuous jaundice for the past three months; stools negative; calculi in gall-bladder.

13. Man age 57 years. Had typhoid fever five years before onset of present trouble. Localized pain; jaundice; acholic stools. Common duct obstructed by enlarged pancreas.

14. Man, age 45 years. Had typhoid fever some years ago during which he had jaundice; vomiting during attacks with pain radiating upwards from the right hypochondrium; has had frequent attacks of jaundice and his stools are frequently acholic; occasional blood in stools and vomitus; calculus in common duct.

15. Man, age 62 years. Severe vomiting during attacks; pain over liver extending to epigastrium; marked jaundice; stools negative, according to patient; occasional chills, fever and sweat; calculi in both gall-bladder and common duct.

16. Man, age 45 years. Had history of typhoid fever preceding the gall-stone trouble. During the course of the enteric fever he was jaundiced and has been much of the time since then. The stools are clay-colored; blood is sometimes seen in the stools, and in the vomitus; vomiting with the exacerbations of pain over the liver radiating upwards; stone in common duct.

17. Woman, age 55 years. Has had no vomiting, jaundice or acholic stools; neither chills nor fever; stools negative. At operation gall-bladder contained many small stones.

18. Woman, age 39 years. Vomiting absent; markedly jaundiced; pain over liver radiating upwards; 184 gall-stones in gall-bladder.

19. Woman, age 33 years. Occasional jaundice; stools negative; pain over liver radiating upwards into right chest; solitary stone in gall-bladder.

20. Woman, age 51 years. Vomiting was present with chills and fever; stools negative; calculi in gall-bladder.

21. Mrs. C., age 47 years. Occasional vomiting with slight jaundice noted; stools negative; pain over liver region radiating into epigastrium and up beneath the sternum; neither fever nor chills; stone in common duct.

22. Woman, age 50 years. Vomiting; jaundice; acholic stools containing gall-stones; hepatic pain; neither chills nor fever; numerous calculi in gall-bladder; a sinus persisted and a subsequent exploration revealed carcinoma of the gall-bladder, but no calculi.

23. Woman, age 66 years. Occasional vomiting, with slight jaundice during attacks; chills and fever; acholic stools; stone removed from common duct.

24. Woman, age 34 years. Severe jaundice; chills with fever and acholic stools were noted; pain was located in lower part of the abdomen; gall-bladder filled with stones; persistent fistula. Returned two years later. Stone found in common duct. This patient died one year later, probably from malignant disease.

25. Man, age 56 years. Early and severe jaundice developed with repeated attacks of chills, fever and vomiting, acholic stools and calculi in the dejecta, the pain commencing in the appendix region, thence passing up to the liver. Very numerous adhesions with small stone in the gall-bladder.

26. Woman, age 30 years. Vomiting; jaundice; chills and fever; acholic stools with pain in right side extending up into right shoulder; many calculi in gall-bladder; pelvic abscess formed and was operated; parotid abscess also developed; recovery.

27. Man, age 48 years. Vomiting; jaundice; pain over liver; normal stools; gall-bladder much dilated and diseased; no stones anywhere; mass in the head of the pancreas.

28. Woman, age 30 years. Patient operated on elsewhere two years previously for gall-stones, but eight months later recovered twenty calculi from the stools. She had had neither jaundice, acholic stools nor aguish attacks. She had daily attacks of colicky pain in the right side, but at operation nothing but extensive adhesions were found, especially between the small intestines and gall-bladder.

29. Woman, age 62 years. No jaundice or acholic stools; pain felt in right side; stone in gall-bladder.

30. Woman, age 47 years. Has had neither vomiting nor jaundice; pain radiated from liver to the left side; calculi in gall-bladder.

31. Woman, age 53 years. Jaundice, vomiting, acholic stools, chills and fever all present, with pain in right side. Stones only in gall-bladder, not in common duct.

32. Woman, age 55 years. Directly following convalescence from typhoid fever somewhat over two years before admission to the hospital, the patient had repeated attacks of severe pain radiating to the centre of the epigastrium with jaundice; neither vomiting nor acholic stools were present; stones in gall-bladder.

33. Woman, age 48 years. Typhoid fever one year before the onset of the gall-bladder trouble; vomiting, marked jaundice, chills and fever; stools negative; gall-bladder filled with stones.

34. Man. Vomiting, slight jaundice, epigastric pain, chills and fever; stones only in gall-bladder and cystic duct.

35. Man. Slight jaundice; vomiting only in first attack; pain over liver extending to the left thigh and also upward; stones in gall-bladder.

36. Woman. Slight jaundice; severe vomiting; pain in right side shooting upwards; calculi in gall-bladder and cystic duct.

37. Woman, age 48 years. Doubtful history of jaundice; movable kidney; operation for fixation of same revealed through the peritoneum a goodly sized fluctuating swelling at and in front of the lower pole of the kidney, closely simulating a distended renal pelvis. Opening the peritoneum, a much dilated gall-bladder was found closely connected with the kidney and filled with stones.

38. Man, age 43 years. Slight vomiting and jaundice with normal colored stools containing numerous calculi. Attacks of severe pain were experienced radiating upwards. A rapidly increasing infiltrating tumor was found on the right side involving the abdominal parietes. At operation an ovoidal segment of the abdominal wall was excised to gain safe access to the cavity. Enormous mass of adhesions involving all the neighboring parts. One large imbedded calculus was removed with innumerable

minute ones scattered among the adhesions. By microscope no malignancy.

39. Man. Obstructive jaundice due to stones which had ulcerated into the stomach and had been vomited before operation, while others were found in this viscus post-mortem. Enormous dilatation of the stomach existed for which a gastro-enterostomy was done.

40. Woman, age about 50 years. Came to me with a correct diagnosis of enlarged stomach due to gastric ulcer, or possibly malignant disease, owing to the detection of a resisting mass in the right hypochondrium. There was an obscure history of what might have been gall-bladder trouble. Operation showed a pylorus and duodenum almost occluded by the adhesions, and an enlarged gall-bladder crammed with stones. Owing to the feebleness of the patient and the primary demand for relief of the pyloric stenosis only a gastroenterostomy was done.

41. Man, age 65 years. Showed symptoms of intestinal obstruction for only forty-eight hours before operation. Operation by a colleague showed that the obstruction was due to a biliary calculus two inches in diameter. He was never supposed to have had biliary disease but had had "stomach trouble" for some undetermined period before this fatal illness.

42. Woman, age 47 years. She absolutely denied, after repeated questioning, that she had had any form of illness before the attack initiating her present illness. She was a cultured woman and denied jaundice, abnormal stools, pain or discomfort, until about one year previous to the time when she came under my care, when an abscess rapidly formed one inch to the left of the umbilicus which had been opened by her attendant, evacuating plain pus. The resultant sinus suggested a small fecal fistula due to ulceration of the bowel in a possible umbilical hernia, but nothing except pus was ever detected. Operation showed a sinus tract extending upwards for about three inches, directed towards the gall-bladder, in which were found a number of biliary calculi. No evidences of bile were found during the operation or the course of her rapid convalescence.

43. Man, age 45 years. Had passed gall-stones on several occasions after attacks of biliary colic, but still had repeated attacks of pain, vomiting, etc. Operation showed that his last attacks could not have been due to the passage of gall-stones,

because the cystic duct was obliterated. Among the dense mass of adhesions a medium sized calculus was found firmly grasped by a shrunken gall-bladder which contained no bile. The gall-stones, which had been previously evacuated in the stools, had evidently ulcerated into the colon, as shown by the conditions found at the operation.

44. Woman, age 47 years. Twenty-nine years ago had severe pain in the right side, in hepatic region, lasting two hours, which radiated to the region of the stomach and into the back. Patient had had similar attacks ever since at intervals of six months; sometimes these attacks will recur daily. Was entirely free for a period of five years. Has never been jaundiced. Stools normal. Never vomited. At operation the fundus was found to be thickened and was removed with a large portion of the gall-bladder, after extracting numerous stones. Pathological report carcinoma.

In the notes of the cases mentioned, one must be struck by the absence of many symptoms usually deemed to be almost universally present in the classes of cases described. Roughly analyzing the symptoms presented by these, with those noted in other cases taken at random from old hospital and private records I have found the following statements warranted. As was to be expected from the probability of infection attacking the smaller bile ducts, because of the passage through them of infected bile at some time during the numerous recurrences of the trouble, jaundice was present in seventy-five per cent. of the cases, but in about one-third of these no calculi existed anywhere in the biliary apparatus. In about one-third the jaundice was practically continuous, but of this one-third more than half were not cases of biliary lithiasis. The evidence of the actual presence of jaundice in a certain number of cases was doubtful, resting solely on the alleged yellow staining of the conjunctiva, which was in some cases declared to be still present by the medical attendant when it was patently absent to my own eyes, and no biliary constituents could be detected in the urine. In this connection too much emphasis cannot be laid

upon the fact that a gall-bladder crammed with stones, provided catarrhal or infective cholangeitis does not occur, need never throughout the lifetime of a patient give rise to the slightest jaundice, hence the absence of this symptom does not exclude the presence of gall-stones, etc.

In about one-sixth of the cases vomiting occurred during the majority of the attacks, while in one-third of the cases studied emesis was only occasional, in some being only present during the first attack.

The number of cases whose notes were sufficiently full to draw any definite conclusions from are too small to lay any great stress upon the percentages given, but they do serve to show the actual happenings in the practice of one surgeon during a given period.

Acholic stools were determined in a little more than one-fourth of the cases, and only in one-eighth of these acholic cases were calculi ever detected in the stools.

Chills, fever and sweats occurred in almost one-third of the cases, while in the remaining two-thirds these symptoms were positively excluded, or had not been recognized by the patient as pronounced enough to be recalled.

Less than half of those suffering from these aguish paroxysms (so commonly thought to be due to common duct stone) had calculi so located, or even duct obstruction from other causes. No attempt is here made to discredit the value of these symptoms as usually indicative of choledoch obstruction, most often from stone, but numerous cases in my practice illustrate the undoubted fact that these symptoms are merely evidences of an infectious process so located that its products can be readily absorbed, so that severe cholecystitis or gangrene of the gall-bladder with cholangeitis may provide the necessary amount of toxic substances and also the jaundice and acholic stools.

The location of the pain experienced during an attack of gall-stone colic is an interesting study. While this point has not been rigorously determined in all the cases upon which this paper is founded, you will recall that in the notes

of a number of those read the pain has been located as follows; over the liver; over the liver and epigastric region; over the liver and abdomen; the appendix region; the right hypochondrium; on the opposite side of the abdomen; on the right side; on the right side not passing beyond the median line; extending from the hepatic region down into the right thigh as well as somewhat upwards; in the epigastrium alone; over the right side and extending upwards; while in only a few cases did the patient describe the pain as commencing in the hepatic region and extending up to the right shoulder, or back of the neck, hence, the absence of the "characteristic pain" believed in by the laity and by many of the profession is of little moment.

Again, an interesting query arises in connection with the uncertain location and character of the pain. What then is hepatic colic? Is it always due to the passage of a calculus? This question is sometimes difficult to determine. In a considerable proportion of these cases, frequent, even daily attacks of pain, perhaps attended with colic were experienced, where no stones were present, or where stones were absolutely fixed by the contracted gall-bladder walls and dense adhesions. Sometimes these attacks were what might be called atypical, but I am convinced from my whole experience that during an attack of biliary colic, it is vastly more likely that a stone does not pass than that one does. Distension of the gall-bladder or common duct from temporary obstruction due to kinking, or ball-valve action of a calculus; slight adhesions or strictures of the ducts; the passage of a small aggregation of cholesterine crystals or biliary sand; all these inducing spasms of the muscular coats of the bladder or ducts; slight attacks of localized peritonitis; gastric tenesmus induced by adhesions; intestinal colic from the same causes; distension of the stomach because of spasmodic pyloric obstruction alone, or this with actual dilatation of the stomach; exacerbations of the ulcerating process in the colon, duodenum, or stomach, whereby large stones are often evacuated from the gall-

bladder; all are conditions that are frequently called attacks of gall-bladder colic in addition to the actual expulsion from the gall-bladder, hepatic or common ducts of a calculus. One of two recent cases of supposed gall-bladder disease experienced frequent attacks of what were considered to be typical biliary colic due to the passage of stones, the attacks sometimes recurring daily from considerable periods, the pain being located in the right hypochondrium and the vomiting being both violent and prolonged. Abdominal section revealed a partial intestinal obstruction produced by a dense band of omentum passing from the hepatic flexure of the colon to the abdominal wall, in its passage downwards being firmly adherent to and constricting the ascending colon. Enormous dilatation of the caput coli and appendix had resulted. The second case on admission had fever, leucocytosis and a painful tumor somewhat above McBurney's point, but there was tympany between its upper border and the liver, yet upon the strength of an alleged slight jaundice, with severe vomiting early in the attack, commencing as soon as the pain became pronounced, the condition was viewed by some of my assistants as one of cholecystitis with calculi. I operated for appendicitis and found nothing but this.

A point of great etiological interest is the fact that seven at least of these patients, perhaps more, had had very recently, or antedating their biliary trouble by a greater interval, typhoid fever. All know that the gall-bladder is not infrequently inflamed in this disease, and also that typhoid bacilli have been cultivated from the gall-bladder of patients who have had enteric fever many years before—in one instance seventeen years, in another twenty years had elapsed. Moreover, non-viable typhoid bacilli are not uncommonly found in the substance of gall-stones.

I shall now ask certain questions warranted by the facts given in the cases cited and confirmed by many others not mentioned. Why should pain be always felt which radiates to the epigastrium, to the right shoulder, or indeed in any special direction, when operation reveals in many instances

that owing to adhesions and perhaps serious ulceration from the pressure of gall-stones, the sources of pain are really not in the biliary apparatus at all, but in the subhepatic and pyloric regions?

Vomiting is in proportion to the pain, the amount of irritation of the splanchnic system, and the consequent vasomotor paresis resembling shock, and to individual idiosyncracy; why then need this be in any way indicative of anything except the severity of the pain?

If the pain must stop suddenly, and this is a proof of the passage of a calculus, why are certain facts easily demonstrable, viz., that in the majority of attacks of so-called biliary colic, the pain subsides rather slowly, no stones are found in the stools, even temporary obstruction of the common duct cannot be demonstrated, and at operation it is often patent that none of the stones, or the stone present, could have even commenced to enter the cystic or common duct?

It must then be clear that to demand the so-called "characteristic pain," the vomiting, the jaundice, the clay-colored stools, the sudden cessation of the pain and the recovery of the stones from the stools, is unreasonable, and resembles the demand for high fever, sweats, generalized abdominal distension, obstinate constipation, marked vomiting, pain and tumor in a definite locality, and inability to extend the right thigh, which a decade ago many practitioners seemed to think must all be readily detectable, before a diagnosis of appendicitis should be made.

Dangerous Sequelae. I have, when reading the notes of cases, or formulating the statements founded on them, called attention to the dangers of cholecystitis and cholangeitis, but for the purposes of emphasis I desire to restate them, premising however, that the probabilities of each complication can neither be stated in figures, nor foreseen in any given case.

Chronic inflammation of the gall-bladder precedes and predisposes to the formation or reformation of gall-stones, with all their dangers. Adhesions to the duodenum, stomach

and colon are common. Compression and obstruction of the common duct may by adhesions lead to chronic cholemia and infective cholangeitis. Gastric adhesions originated by cholecystitis and its sequelæ more often produce so-called stomach disease and serious dilatation of this organ than is commonly believed. Should virulent infective organisms reach the chronically diseased gall-bladder, acute suppuration with rupture, or even gangrene, may result with all its possible sequences. Carcinoma of the gall-bladder is not an uncommon sequence of cholelithiasis. See cases 22, 24, 44. These direful results have nearly all been exemplified in the histories of my cases.

Once gall-stones are formed, all the dangers attending cholangeitis are present, with the greater risks of suppuration, rupture, gangrene, stomachic and intestinal crippling, and ulceration involving the stomach or colon, with all its dangers; dilatation of the stomach; carcinoma; intestinal obstruction from a large stone, perhaps increased in bulk by calcareous intestinal accretions; and fatal hemorrhage, even without operation.[1] A greater refinement in analysis might perchance reveal some other obscure dangers, but what has been already said really embraces all of importance.

Diagnosis.—When temporary obstruction of the common duct has occurred on more than one occasion with jaundice, pain—characteristic (?) or not—the stools being acholic, aguish paroxysms having been noted with sudden cessation of pain, rapid clearing up of symptoms, and the recovery of calculi from the stools, he who runs may read, but with the irregular symptoms which many cases present the matter is not so easy. A diagnosis can best be made by exclusion. Stomach and duodenal ulcer, gastric carcinoma, neoplastic obstruction of the bowels, acute or chronic pancreatic disease, intestinal obstruction by bands, dilated stomach, renal calculi or disease, a dislocated kidney which is sometimes accompanied with jaundice, appendicitis, the gastric crises

[1] More than one such case has occurred recently at the University Hospital.

of locomotor ataxia, and spinal caries must all be considered, while examination of the urine often gives valuable information by revealing the unsuspected presence of biliary substances when jaundice has passed away or is too slight for a certain opinion. The association of appendicitis and cholecystitis must not be overlooked. Without going into the differential diagnosis of the affections mentioned, you will readily understand that during these investigations, it is hardly possible not to recognize such conditions as will lead you to investigate the biliary apparatus so rigidly as to arrive at correct conclusions in the absence of all supposedly pathognomonic symptoms. Again, despite all care, doubt may still exist between gastric and duodenal ulcer, disease of the pancreas, and appendicitis, or even a neoplasm. In such cases, because an operation can alone afford relief for any of these conditions, and when one incision will enable the surgeon to deal with any or all of these ailments, if present, an exploration should be made.

In conclusion let me again urge, that this paper simply represents the average conditions presented by cases, gathered at random, not that another series in my own practice would necessarily present exactly similar complications or symptoms.

My object will have been secured, if I shall have induced some of my readers to recognize the existence of many serious hepatic and biliary conditions, which can only be properly met by use of the knife. If these conditions must be recognized early to secure the best results, a diagnosis must be often reached by discarding the group of symptoms usually relied upon, and reaching correct conclusions by a careful analysis of the symptoms, viewed in the light of anatomy, physiology and modern pathology. In certain rare cases, as already said, only an exploration will decide the question.

THE VALUE OF THE DIFFERENTIAL LEUCOCYTE COUNT IN ACUTE APPENDICITIS.

BY ALFRED H. NOEHREN, M.D.,

OF NEW YORK.

Interne at German Hospital.

THE question of the value of blood examination in acute abdominal conditions is still the subject of much difference of opinion. The principal reason for this is that the statistics so far collected and published on this subject are few and therefore no definite conclusions have been reached. If it can be demonstrated that blood examination is an aid in deciding doubtful cases and in determining indication for immediate operative intervention, its value to the surgeon becomes very great.

To furnish additional data on this question is the purpose of this paper. It is based on 72 cases of Appendicitis and its sequelae in which a blood examination was made just previous to operation, so that the result of the examination can be compared with the actual condition present. The cases are from the services of Drs. Kammerer, Kiliani, and Willy Meyer at the German Hospital, New York.

The findings at operation have been divided into 5 classes:

1. Diffuse Peritonitis (D.P.)—Free pus in the greater part of the peritoneal cavity.

2. Spreading Peritonitis (S.P.)—Free pus in a limited portion of the abdomen, but not walled off by adhesions.

3. Gangrenous Appendicitis (G.A.)—Appendix gangrenous to greater or less extent, not walled off by adhesions.

4. Inflamed Appendix (I.A.)—Appendix inflamed, no gangrene, no perforation, no adhesions around it. Empyema of appendix without gangrene is included in this class.

5. Abscess (A.)—Pus outside of appendix, but walled off by adhesions from the remainder of the peritoneal cavity.

When blood examination in acute surgical conditions first came into practice, the amount of leucocytosis only was considered. An increased number of leucocytes meant the presence of inflammation or of pus, an increasing leucocytosis meant extension of the process, an absence of leucocytosis above 10,000 signified a mild process.

In 69 cases of this series, the leucocyte count and the conditions found at operation were as follows:

	D.P.	S.P.	G.A.	I.A.	A.	Total
Under 10,000	—	—	2	2	3	7
10,000–15,000	5	1	2	8	8	24
15,000–20,000	3	1	3	7	7	21
20,000–25,000	2	1	1	1	4	9
Over 25,000	2	1	3	—	2	8
						69

A study of this table shows that a leucocytosis above 10,000 may mean anything from a general peritonitis to a simple inflamed appendix or encapsulated abscess. A leucocyte count alone, therefore, is of no aid in diagnosing the severity of the condition or the necessity of immediate operation.

Dr. Frederick E. Sondern, who has done much work along this line, attaches great value to the differential leucocyte count as an aid in diagnosing the severity as well as the presence of intra-abdominal conditions. He says:[1] "The increase in the relative number of polynuclear cells is an indication of the severity of the toxic absorption, and the degree of leucocytosis is an evidence of the body resistance toward the infection. . . . Purulent exudates were rarely, if ever, present with low polynuclear percentages, irrespective of the height of the leucocyte count, while very

[1] "The Value of the Differential Leucocyte Count in Diagnosis," Am. Journal of Medical Sciences, Dec., 1906.

high polynuclear percentages almost invariably indicated their presence, even if the total leucocyte count was low."

The body resistance, which Dr. Sondern says is measured by the degree of leucocytosis, we can disregard for our purpose. It is of little importance in the question of deciding for operation in surgical conditions, because, if these conditions are present, operation must usually be done.

On the other hand, the severity of infection is a very important point in deciding whether operation is necessary at once, or can safely be postponed. If the percentage of polynuclears is an index of the severity of the process, it ought to be a very important aid to the surgeon.

In 60 cases, in which a differential count was made, the results and findings were as follows:

	D.P.	S.P.	G.A.	I.A.	A.	Total
Over 90 per cent.	3	1	3	1	—	8
85–90 "	6	—	2	5	6	19
80–85 "	2	1	3	2	4	12
75–80 "			2	5	6	13
Under 75 "				4	4	8
						60

We see from the above that in every case with 90 or more per cent. of polynuclears, immediate operation was surely indicated, except in one, and even in that case there was an acute inflammation of the appendix. Every case under 80 per cent. could probably wait, being either an encapsulated abscess or a simple inflamed appendix, except in two cases of gangrenous appendix, both of which had 78 per cent.

These figures would make us conclude that every case of appendicitis with 90 per cent. or more of polynuclears needs immediate operation, whereas every case under 78 per cent. can safely wait for further developments.

Let us take the cases between these two extremes and tabulate them in detail.

	D.P.	S.P.	G.A.	I.A.	A.
78 per cent.	—	—	2	—	—
79 "	—	—	—	1	4
80 "	—	—	1	3	2
81 "	—	—	—	—	1
82 "	—	1	1	—	—
83 "	2	—	1	—	—
84 "	—	—	—	—	1
85 "	—	1	1	1	3
86 "	3	—	—	—	1
87 "	1	—	—	1	2
89 "	1	—	1	2	1

The cases of peritonitis are grouped among the higher percentages, but the other conditions are about equally distributed.

Our conclusions then would be: a percentage of 90 or more of polynuclears indicates a very severe process that needs immediate intervention; a percentage below 78 indicates a mild or "safe" process in which immediate operation is not necessarily indicated; between these two, the higher the percentage the more likely is the process to be a severe one, without, however, excluding the possibility of a mild or safe process.

Another phase of this subject is presented by Dr. Chas. L. Gibson.[2] He emphasizes "the relative disproportion of the polynuclear percentage to the total leucocytosis" as being more reliable than the leucocyte count alone or the polynuclear percentage alone. He says: "It (this relative disproportion) is of value chiefly in indicating fairly consistently the existence of suppuration or gangrene. . . . The greater the disproportion, the surer are the findings, and in extreme disproportions the method is practically infallible."

He suggests the use of a standard chart in which a base-line represents 10,000 leucocytes at its left extremity and 75 per cent. polynuclears at its right extremity. Every centimetre above the base-line represents 1000 additional leu-

[2] "The Value of the Differential Leucocyte Count in Acute Surgical Conditions," ANNALS OF SURGERY, April, 1906.

cocytes and 1 per cent. increase in the polynuclears. For instance, for a case with 16,000 leucocytes and 88 per cent. polynuclears, a dot is made at the left 6 cm. above the base-line and at the right 13 cm. above the base-line. The two are then connected by a straight line, which in this case would be a rising one from left to right.

In 20 cases of acute appendicitis he found a rising line, in 2 cases it was horizontal, in 3 cases it had a downward tendency. He says: "All the severe lesions, those with gangrene of the appendix or progressive peritonitis, showed a rising line, while all the cases indicated by a falling line were distinctly mild types, such as well defined safe abscesses."

Let us see how our cases bear out this statement. In 52 cases in which both a leucocyte count and an estimation of the polynuclear percentage was made, the results were as follows:

	D.P.	S.P.	G.A.	I.A.	A.	Total
Rising line	7	1	4	7	4	23
Horizontal line	2	—	1	1	2	6
Falling line	2	2	4	5	10	23
						52

Although the majority of our cases bear out Dr. Gibson's statement, there are so many exceptions that it hardly seems of much value to the surgeon. Thus, of 14 cases of diffuse or spreading peritonitis, 6 showed either a horizontal or a falling line, and, judged by the "standard chart," would be "mild" cases.

In addition to the above cases, one other deserves mention. The patient had symptoms suggestive of a spreading peritonitis following appendicitis. Blood examination: 20,200 leucocytes, 86 per cent. polynuclears, almost a horizontal line by the "standard chart." At operation a ruptured ectopic pregnancy was found with blood clots in the peritoneal cavity. Immediate operation was clearly indicated.

A study of the above tables shows that of the three methods of blood examination described, estimation of the number of leucocytes alone, the percentage of polynuclears alone, and the relative disproportion between the two, the second is the most reliable. Not only is it the most reliable, but it is of positive value in diagnosing the severity of abdominal conditions and deciding the question of immediate operation.

Furthermore, as the estimation of the polynuclear percentage is a very simple procedure, requiring only glass slides, a stain, and a microscope, and can be more quickly and easily done than the counting of the leucocytes, it should not be neglected in any acute case of appendicitis. If it results in one of the absolute percentages, 90 per cent. or above, 78 per cent or below, it alone can be relied upon in determining immediate operative interference. If it lies between these two, it will add just so much to the physical signs and history, according as it approaches the one or the other extreme.

I will cite just one case out of many where it practically determined the diagnosis of the severity of the condition.

Man admitted to hospital with history of one previous attack. Two days before admission had sharp pain in upper part of abdomen with vomiting. Next day pain localized in lower right quadrant. Physical examination showed marked tenderness and rigidity of lower half of right rectus muscle, but with an indefinite feeling of a mass. Slight tenderness and rigidity of lower half of left rectus muscle. Leucocytes, 14,800; per cent. of polynuclears, 87.

Here was a case in which it was difficult to make a diagnosis between spreading peritonitis and beginning abscess formation. But 87 per cent. of polynuclears in this case, according to our findings above, would speak for the severer process. Operation was done immediately and a gangrenous appendix with free fluid in the peritoneal cavity was found.

CONCLUSIONS.

1. Blood examination in cases of acute appendicitis is of great value in determining the severity of the condition and therefore deciding whether or not immediate operative interference is indicated.

2. The degree of leucocytosis, formerly considered an important diagnostic aid, is too variable to be of any practical value.

3. The relative disproportion between the percentage of polynuclears and the degree of leucocytosis is reliable in a majority of cases, but the number of exceptions is so great that its practical value in determining immediate operation becomes very small.

4. The estimation of the percentage of polynuclears alone is more reliable than either of the preceding methods and therefore, together with the fact that it is the one most easily made, the method to be recommended.

5. A polynuclear percentage of 90 per cent. or more indicates a severe process that needs immediate operative interference; a percentage below 78 per cent. means a "safe" or mild process; a percentage between the two extremes speaks for the one condition or the other according as it approaches the one extreme or the other.

A NEW TECHNIQUE FOR DEALING WITH THE APPENDIX STUMP.

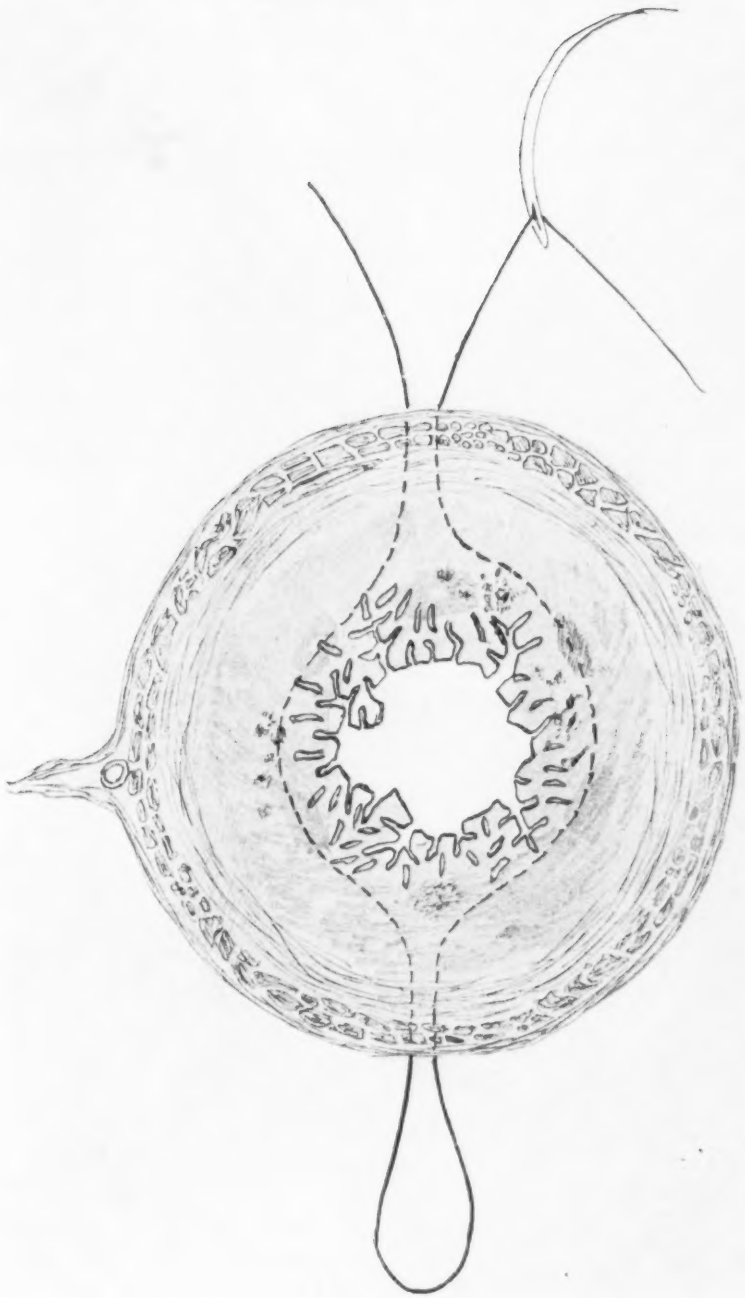
BY CHANNING W. BARRETT, M.D.,

OF CHICAGO.

As the larger questions of appendicitis have been settled we are now as perhaps never before turning our attention to the technique. Numerous papers have been devoted to the management of the stump. Many cases are operated upon to relieve minor but persistent or oft recurring symptoms. The disability is not great, but this may lead to a severe attack. To encourage the acceptance of surgical relief before the severe attack occurs, the operation should have the following advantages:—1. It must be safe. 2. It must reach the appendix through as small an opening as is consistent with good work, in order that the abdominal wall shall not be unnecessarily weakened. 3. No considerable stump of appendix should be left outside or inside the bowel. 4. The stump should be dealt with in such a way as to have no opportunity for leakage of feces or septic material from the bowel, and should allow no possibility of hemorrhage into the bowel, or peritoneal cavity or cellular tissue. 5. No unnecessary opportunities for adhesions should be created. 6. The above advantages in dealing with the stump should be attained without tedious sewing, undue manipulations, or unnecessary opening of the bowels.

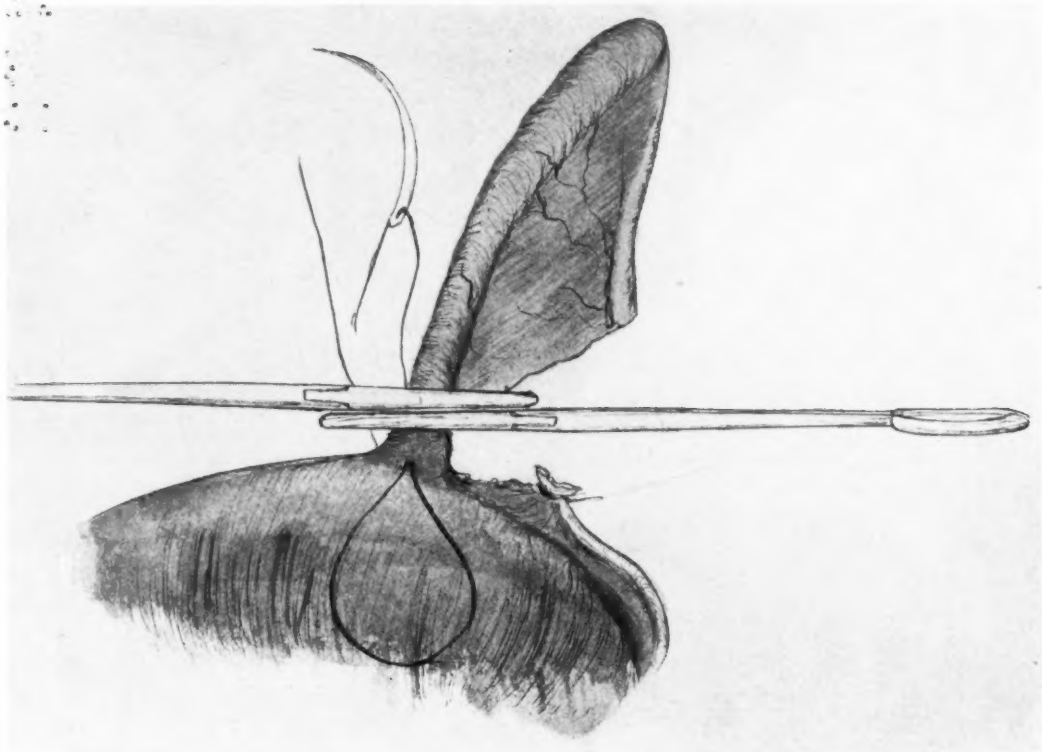
The method of tying the stump and leaving it uncovered, formerly practiced and again being revived, is easy of application and allows of no immediate escape of bowel contents, but often leaves an undue portion of the appendix, necessitates a non-absorbable ligature, leaves opportunities for adhesions, and, above all, connects the bowel cavity with the peritoneal cavity by means of a tied fistula lined by mucous membrane, which is difficult to obliterate. This may not have the same

FIG. 1.



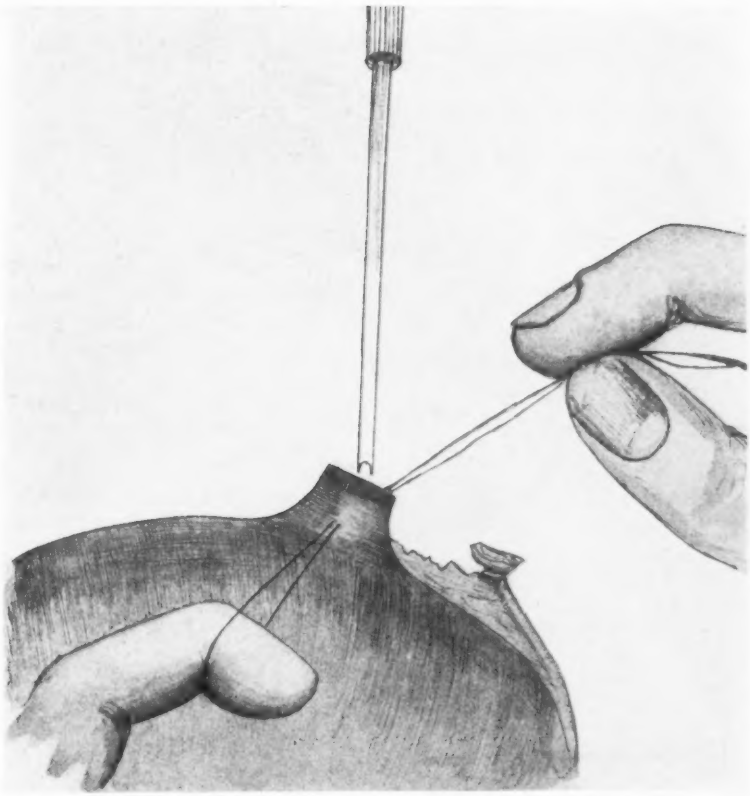
Showing the method of placing the suture.

FIG. 2.



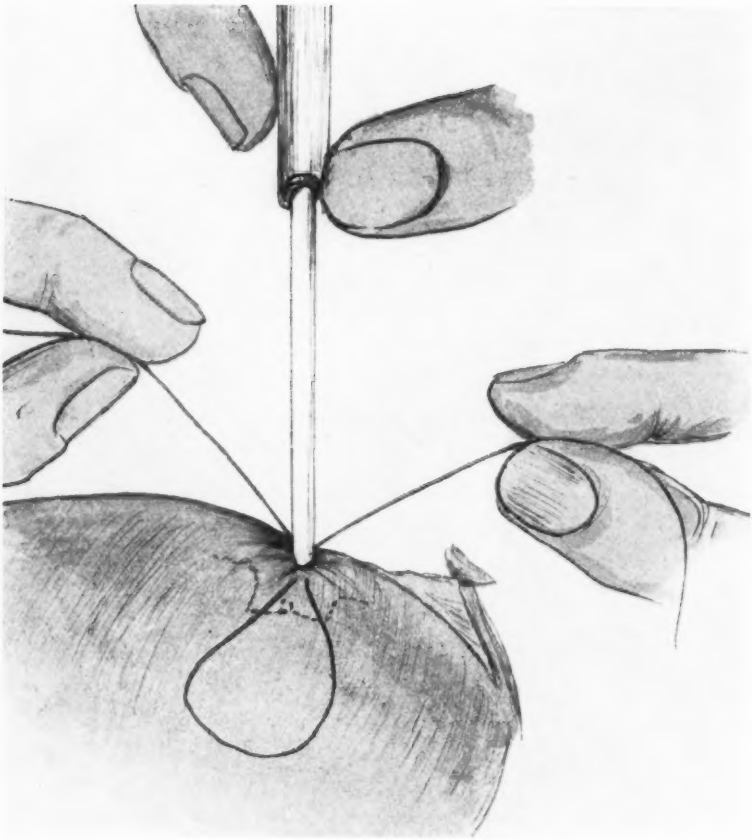
Mesoappendix tied, cut and pushed down, leaving the appendix free. The suture is placed at the base of the appendix, as shown in Fig. 1.

FIG. 3.



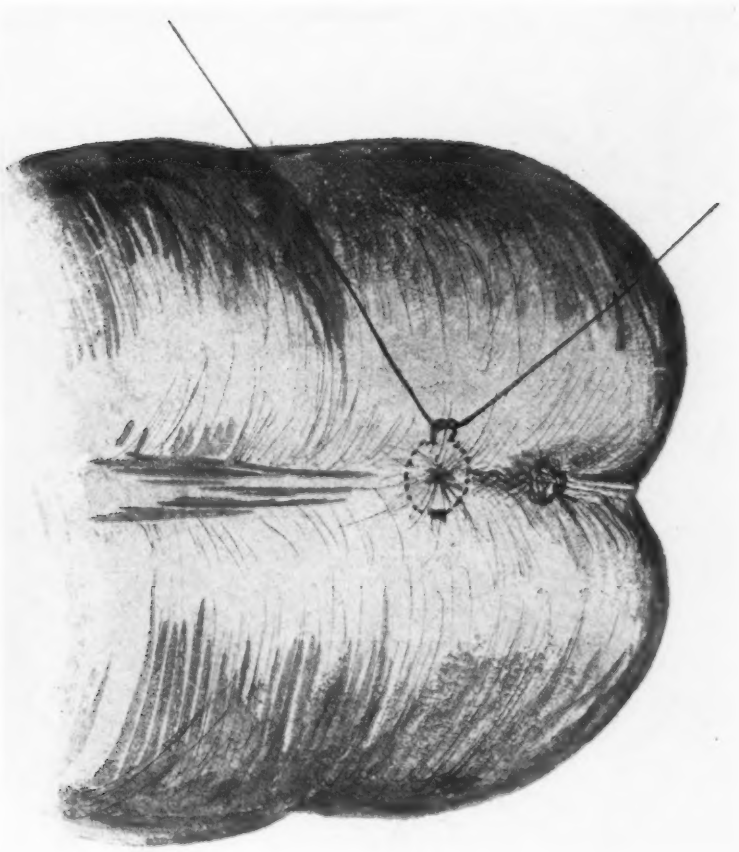
Appendix cut after being crushed and ready to be inverted with the tucker.

FIG. 4.



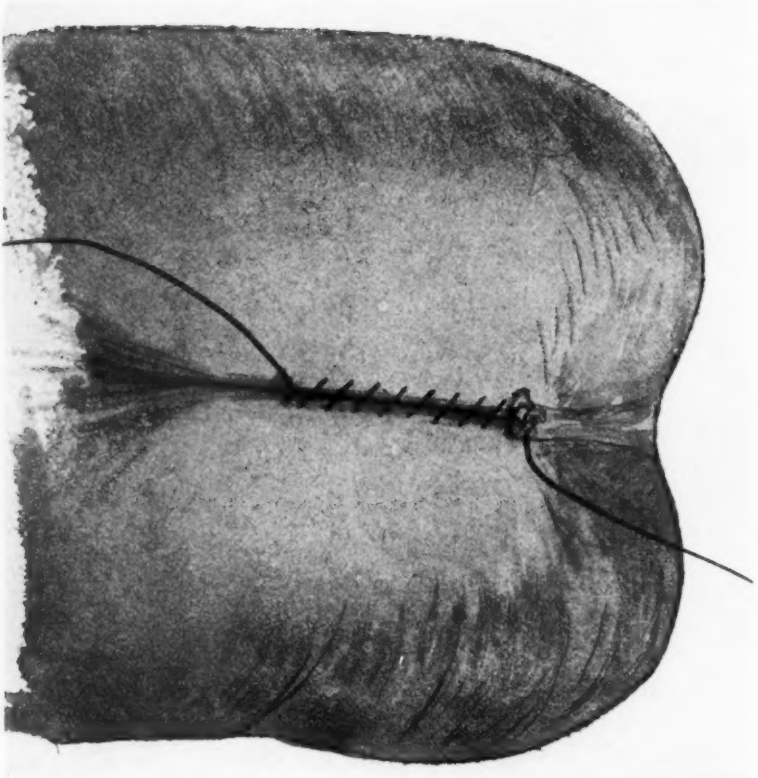
Appendix inverted, showing stump with a dotted line.

FIG. 5.



Ligature being drawn down. This is done as much as possible before the tucker is removed.

FIG. 6.



Appendix region overstitched with running Lembert suture, which is then tied to one on mesoappendix.

FIG. 7.

Double pointed tucker.

objection in cases in which draining is necessary, but in clean cases, where ideal surgery may be done, this is unsurgical.

The method of dissecting the appendix out of the cæcum and closing with interrupted suture has the advantage of getting rid of all the appendix but the great disadvantage of an open bowel while manipulations are going on, with the possibility of leakage of feces. It introduces into the clean appendicitis case the dangers incident to intestinal surgery with their added mortality. The cuff method has the disadvantage of mucous membrane to mucous membrane, is tedious and has nothing to commend it, if the tying off of the whole stump is safe and furnishes a pocket for infection if the stump is infectious. The same may be said of sinking the tied stump by means of a purse string. The purse string method may be made to prevent leakage of feces, is quickly done, and leaves little opportunity for adhesions but is now being condemned because it does not sufficiently provide against hæmorrhage. The technique of Harris making the ligature include the artery obviates this to some extent, but it is not entirely reliable. The method proposed of tying the appendix in the cæcum is impractical and dangerous. A method which I now present depends for its success upon the following facts: that portion of the stump which lies outside the ligature before the stump is inverted is the only portion tied, the rest lies in direct communication with the bowel untied. Unlike the ordinary purse string suture, then, the suture is so placed that all the vascular portion of the appendix lies outside the suture as shown in the cut. The technique is as follows:—With as small an incision as possible the appendix is secured and freed from adhesions, the mesoappendix is clamped, tied and cut so that the appendix stands up directly from the bowel. A number two catgut of good tensile strength is used on a straight or curved needle. The needle enters the tissue at the junction of the bowel and appendix one-fourth the circumference from the mesoappendix. It is made to enter the deep structures and yet avoid the lumen and come out on the opposite side of the appendix. It is then made to enter very close to its exit, sweep

around the opposite side of the lumen in the deep structure and emerge close to its former entrance. A loop of the catgut is retained opposite the two ends. We now have nearly all the appendix lying outside the suture. The appendix is clamped a little distance above the suture. Another clamp is placed immediately above this and the appendix cut between the forceps. The ligature is now made to hold the cæcum by traction upon its two ends and the opposite loop. The forceps are now removed and a forked appendix tucker is made to carry the crushed stump into the bowel. At the same time the ligature is drawn down and encircles the tucker but may be drawn as tight as desired, as the tucker cannot hold on to the stump. All forceps used to invert the stump have a tendency to hold to it and return it. The one-point tucker is worse than useless in dealing with the untied stump, leaving the forceps to be preferred.

The operation is completed by overstitching the stump with a continuous Lembert suture, carrying it along the free edge of the mesentery running to the mesoappendix stump and this suture is tied to one end of the ligature on the mesoappendix.

This operation then ties all the vascular portion of the appendix, turns the raw edges in, brings peritoneum to peritoneum, does not pucker the bowel, and these advantages are gained through the use of a suture which is easily placed, making the operation safe and easy of performance.

OBSTRUCTION OF THE INTERNAL URINARY MEATUS BY FOLDS OF MUCOSA.*

BY WILLIAM JONES, M.D.,

OF PORTLAND, OREGON.

WHEN an elderly, or old man presents himself for relief of difficult urination the inference is immediately drawn, that enlargement of the prostate is the cause of the trouble. If on examination the prostate is found to be enlarged, and residual urine is present in considerable quantity, the proof against the prostate is considered conclusive, and removal of the gland the only radical and sufficient remedy. This in brief, outlines the attitude of the profession at this time.

Some personal experiences in this class of cases, and some matters of common observation have led me to gradually modify this view.

It is a matter of common knowledge that much enlargement of the prostate frequently exists, without producing obstruction to any appreciable extent. I have, and I believe most surgeons have, met with cases of considerable enlargement where ability to empty the bladder easily was present, in these cases the enlargement is usually uniform and symmetrical.

Where the prostatic enlargement is irregular and unsymmetrical, obstructive symptoms are much more likely to be present. When the enlargements are sub-vesical and sub-urethral they can be completely and radically removed by the perineal route, and this I believe to be the best direction of approach for their removal. When they project well into the interior of the bladder forming, as it were, intra vesical growths their complete removal by the perineal route is very problematical and uncertain. The first case that caused me to realize this fact in a practical way was the following:—

*Read before the Portland Academy of Medicine, October 10, 1906.

The patient, 65 years old, was referred to me for removal of the prostate, with the following history: He had been annoyed by the necessity of passing urine with more frequency than normal, and being obliged to get up two or three times at night to empty the bladder for a period commencing one year previously. About one month previous to consulting me these symptoms had rapidly increased and the force of the stream had diminished, until for the last two weeks he had been obliged to depend entirely upon the catheter. On examination the prostate was found to be greatly enlarged in a uniform and symmetrical way. The soft catheter passed very easily, and there was no cystitis. Operation was advised and accepted; the gland was removed by the perineal route with the full expectation and belief that it would remove the cause of the obstruction; a drainage tube was left in for four days, then removed; the urine dribbled from the wound for a few hours, then stopped altogether; neither could he voluntarily pass any urine; it was necessary to resort to the use of the catheter. After a few days without being able to pass any urine, it became apparent that the real cause of the obstruction had not been removed. This was stated to the patient with the recommendation that a supra-pubic operation be done. This proposal was accepted and accordingly carried out. It revealed a very thin collar of tissue arising about the internal urinary meatus, in the shape of a horse-shoe, with the opening of the shoe toward the pubes.

This tissue was not perfectly flabby but had a little rigidity, sufficient to cause it to stand erect about the outlet of the bladder; it yielded, however, to the slightest pressure, and collapsed into the opening, completely closing it like a valve. When the bladder was empty there was no pressure to force it into the opening, but when the bladder was more or less filled the pressure of urine within it would be sufficient to make the valve effective. This collar was excised down to the muscular layer all around the opening. When the supra-pubic wound closed, he was able to pass urine and empty his bladder. Macroscopically the specimen was made up of a very thin layer of mucous membrane folded over a thin layer of fibrous tissue. This dense tissue seemed to be an upgrowth from the prostate and was the efficient cause of the obstruction. Its removal primarily would probably have been sufficient without the removal of the gland.

There is another form of obstruction of the internal urinary meatus, having its origin in the prostate, that I have encountered,—that is a small pedunculated growth, rising into the bladder and projecting itself into the opening. I have met with one case of this sort.

The patient was 65 years old. He had been troubled with some frequency of urinating, but had thought but little of it. Suddenly he observed the urine to be bloody. This alarmed him and he sought medical advice. On examination it was found that his bladder was greatly over-distended, even after he had passed as much urine as possible. The soft catheter was somewhat obstructed as it passed into the bladder. No enlargement of the gland could be made out. It was decided to catheterize him regularly, in the hopes that the bladder would gradually return to its normal condition. However, on passing the catheter the next time, greater resistance was encountered. The succeeding time it was impossible to pass the soft catheter, and the silver catheter was used. It was impossible to pass any catheter after this. Under the pressure of necessity, the patient consented to a surgical operation. A supra-pubic opening was made in the bladder which revealed a pedunculated tumor the size of a very large pea, springing from the bladder wall just at the posterior margin of the internal urinary meatus; it dropped into and closed the opening like a ball valve. It was removed partly by cutting with the scissors, and partly by twisting. It seemed to be of prostatic origin (which was proven later by microscopic section). It had evidently grown from the surface of the gland, forcing itself gradually upwards until it had become intravesical. There was no enlargement of the prostate whatever that could be detected by bimanual examination from within the bladder and within the rectum.

When the supra-pubic wound healed he was able to pass urine though not to empty the bladder. Daily catheterization was continued for a considerable time, and the residual urine gradually diminished. At the last examination it was moderate in amount. It has been my experience that when the bladder has been greatly overdistended for a long time from a mechanical obstruction that the power to completely empty the bladder is

not wholly regained even after the obstruction has been completely removed.

There is another form of obstruction of the internal meatus, that is not of prostatic origin, with two cases of which I have met. The relation of these cases will best describe the lesion.

The first case was a pilot, 69 years of age, who was referred to me for removal of the prostate. He had not passed urine in a natural way for twenty years; during the whole of that time he had depended upon the catheter, which passed without any obstruction. For the last two or three years he had suffered from the effects of catheterization, such as repeated attacks of orchitis and a mild cystitis. This had brought him to seek surgical relief. Upon examination only the slightest enlargement of the prostate could be made out. However, being still unduly under the influence of the prostatic tradition, I concluded that the gland must be the cause of the obstruction, and prepared to perform the operation of its removal, for which he had come. It was carried out by way of the perineum. On removing the drainage tube, he could not pass any urine, and the catheter had to be used as before. After waiting a few days, there being no change for the better, the obstruction remaining absolute, a supra-pubic opening was recommended and accepted. This disclosed the obstruction to be a fringe of mucous membrane that grew all about the meatus, which dropped into and closed the urinary passage; but it offered no sign of resistance to the passage of the catheter. This was excised all about down to the muscular layer. When the supra-pubic wound closed he was able to pass his urine and empty his bladder. There was no dense tissue in the specimen and no indication of a prostatic origin.

The second patient was 65 years of age. When he consulted me he had suffered incontinence of urine for a month and gave the usual history of gradual increasing frequency of urination, particularly at night. This had extended over a period of about a year. On examination I found a tumor rising nearly to the umbilicus. He passed as much urine as he was able to, which was very small in amount. Introducing the soft catheter, which easily passed, 50 ounces were withdrawn. There was no en-

largement of the prostate whatever, and it was perfectly uniform in shape. Regular catheterization was carried out twice a day for several days, to see that the bladder was not allowed to become overdistended, in the hopes that it would regain its power to empty itself. The amount withdrawn each time was practically the same. The activity of the kidneys was prodigious to fill and overflow this viscus twice a day.

A supra-pubic opening in the bladder was made, and showed the same sort of obstruction as in the preceding case, that of the pilot. This was excised. When the supra-pubic wound was closed he could pass his urine, but there were 12 ounces residual. The catheter was used once a day for a month, when the residual urine was reduced to two ounces. At this time he left for home, with instructions to use the catheter once a day until the residual should be reduced to about one ounce, and then to use the catheter at longer intervals.

In another case the obstruction was of a still different character. Patient aged 56; previous genito-urinary history negative. For past year had had increasing difficulty in passing the urine. Latterly there had been increasing desire to urinate, but ability to pass but a very small amount at a time. Examination showed the prostate not to be enlarged, and the bladder to be overdistended. After observing him for a few days and there being no improvement, a supra-pubic opening was made in the bladder, which revealed the presence of a band or fold immediately posterior to the internal meatus and encroaching upon it. This was deeply divided with the scissors. When the supra-pubic wound had healed he was able to pass urine easily and empty the bladder completely, and has continued to do so since.

In my opinion these obstructions are of rather common occurrence, and the proper route by which to remove them is the suprapubic.

POSTOPERATIVE X-RAY TREATMENT OF MALIGNANT DISEASE.*

BY RUSSELL H. BOGGS, M.D.,

OF PITTSBURG, PA.

THE purpose of this paper is to show the necessity of referring malignant cases early for post X-ray treatment, and not waiting until recurrence has taken place, as has been the case in many instances in the past. We should never ask one horse to pull a twenty horse power load. Another oversight, which is common among surgeons, is that the patient is told that X-ray treatment should be given, without mentioning that there is any difference in the manner in which the treatment is administered.

It is the duty of all to urge the necessity of radiation being given in such a manner as to saturate the site of operation, and also the adjacent lymphatic glands, thus producing a physiological result. In prescribing mercury for syphilis, great fear of producing salivation would not induce us to prescribe 1/100 of a grain when two grains were indicated. The same is true in treating carcinoma with the X-ray.

This comparison appealed to me after having gone over the subject with a number of surgeons and Roentgenologists, and having been consulted by at least a dozen patients during the past year, where a recurrence has taken place. None of these cases showed any evidence of radiation although one patient had received fifty treatments.

Inadequate treatment is not only useless, but I believe, small doses stimulate growth of tissue, while efficient radiation retards and destroys new growths.

A study of the lymphatic glands and of their involvement by carcinoma where the adjacent organs are effected,

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* Read before Pittsburg Academy of Medicine, Nov. 26, 1907.

as well as the physiological action of the X-ray on lymphoid tissue must be understood, before either the surgeon or Roentgenologist can speak intelligently of post X-ray treatment. Otherwise his opinion may be based upon cases which were not carcinoma at all, or upon the results obtained in cases which were hopeless when referred for treatment, or cases improperly treated. One physician has referred to me at least fifteen cases of recurrent carcinoma in which the deep glands were involved, none of which lived over three years, and because none of these cases lived over three years, he discredits the value of X-ray in malignant disease, although all the external signs of recurrence cleared up in at least five cases. Now, had he referred these cases within a few days after operation and had the glands adjacent to his lines of incision been rayed to such an extent that these glands had been obliterated, that is to say, had undergone a fibrous degeneration, possibly the results would have been different in some cases at least. The great trouble has been, that much of the post X-ray treatment has been given in a half hearted manner without really knowing what physiological results should be obtained.

In the past the possession of an X-ray machine was all that was thought necessary, but in the future since the pathologist has come to our assistance and has told us why we are obtaining results, and since we are able to give a therapeutic dose the value of the X-ray has changed.

The treatment of malignant disease by the X-ray varies with the situation, and no rules can be laid down unless so modified, as no one would state that the X-ray is as useful in the treatment of carcinoma of the uterus as in epithelioma. It is a question whether we can expect to even prevent recurrence in carcinoma of the uterus on account of the adjacent glands being so deeply situated, while in cancer of the skin it is a question if it is necessary to operate at all in many cases.

Probably, post X-ray treatment is the most useful in carcinoma of the breast, because here the adjacent glands

under the clavicle and near the site of the operative field can be made to undergo fibrous degeneration by a number of post X-ray treatments, but if the bronchial and mediastinal glands are involved, I believe, the operation is not only useless but also the X-ray treatment as far as a permanent cure is concerned.

A word in regard to cases where recurrence has taken place, following the Halsted operation. Out of a series of cases where recurrence has taken place, with nodules studded over the chest, I have been unable to apparently cure more than three cases, although some lived over three years. These cases all had bronchial and mediastinal involvement when radiation was begun. However, in about twenty-five per cent. of these cases all external signs of the disease disappeared, and the patient improved in general health, more than likely this was due to the increase in metabolism which takes place under Roentgen treatment. To prove that bronchial metastasis had taken place when X-ray treatment was begun and that the radiation had nothing to do with internal glandular involvement, I made radiographs of a number of these cases and found the bronchial glands enlarged when they were referred.

When such a condition exists is it worth while raying these cases? This is answered by stating that the patient's life is prolonged from six months to three years and the health improved for a time at least.

Now what should we do when a patient with carcinoma of the breast presents herself for treatment? I am going to suggest the following from experience gained from studying a number of cases.

(1) If only a mass in the breast:—The mass should be removed, a pathological examination made and if found to be cancerous, a complete operation done followed by X-ray treatment.

(2) If there is only a small amount of glandular involvement, complete operation followed immediately by intense X-ray treatment.

(3) If there is an extensive glandular involvement:—Intense radiation given daily until the axillary glands cannot be palpated. Then complete operation and X-ray, if it is given at all, given cautiously.

The last statement was made from the study of ten such cases where glandular involvement was extensive and operation did not seem advisable when the diagnosis was made.

To briefly summarize these ten inoperable cases (classed as inoperable as there was extensive involvement of both axillary and supra-clavicular lymphatics, together with broken down masses or masses about to break down), seven were operated upon after thorough radiation. In only two of these cases was there a radical or Halsted operation done. and in the other five a modified operation was performed. Of the two complete operations, one is living four years and one died within twenty-four hours. Of the five modified operations, two lived over three and one-half years and one died within six months. The other two are living and no sign of recurrence, one at five and the other at seven months after operation. Of the cases not operated, one lived one year and the second is much improved after six months. The third case has been in good health for four and one-half years and the small hardened mass in the breast has remained stationary and freely movable and the glands in axilla which were as large as a walnut when treatment was begun cannot be palpated at all.

I have repeatedly urged that both these cases be operated upon.

Strange, as it may appear the benefits derived from ante-operative treatment in the above cases is marked compared with the results obtained in the treatment of recurrent cases after operation. This leads me to believe that all cases of carcinoma of the breast should have thorough anteoperative X-ray treatment or early and competent postoperative radiation.

Three surgeons after operating on several cases in

which anteoperative Roentgen treatment had been given made the following statements:

The enlarged lymphatics are if palpable degenerated into fibrous cords, the tumor mass is surrounded by scar tissue, its center having undergone caseous degeneration. A very noticeable and gratifying result of ante-operative X-ray treatment is the almost complete disappearance of the normal scar tissue which follows operation.

Sarcoma.—The malignancy of sarcoma varies more than carcinoma and therefore the end results are not as good by any form of treatment. I have treated about twenty-five cases, all of these except eight were inoperable when they were referred, and out of the hopeless class I have only one case which has remained well without a recurrence over fifteen months, although some of them have lived for over two years.

This was in an inoperable sarcoma, at the junction of the sternum and clavicle, about twice the size of an orange, and very painful. Treatment was given in series for a period of six months when the mass was reduced to about the size of an egg. The patient refused operation and it was not urged as we considered that it would recur whether we operated upon it or not. Several similar cases remained stationary until they were removed when internal metastasis occurred promptly. It has remained stationary fifteen months, but it certainly is only a question of time until the result will prove fatal.

Of the others nearly all showed some improvement after the first fifteen or twenty treatments, that is to say the tumor decreased in size and the patient's general health would be much improved. In three lympho-sarcoma's the results were more marked, and one case, that had been refused operation in Baltimore, the mass in the neck almost disappeared for a period of six months when Coley's toxines were added to the X-ray. From this time the patient rapidly became worse and died from metastasis.

I have used Coley's toxines in a few cases but I cannot

say that the results have been any better, and I am of the opinion that the Roentgen rays must be given more carefully, if given in conjunction with the toxines.

At the 1905 meeting of the American Roentgen Ray Society held in Baltimore, Dr. Coley read a paper, and out of sixty-eight inoperable cases treated by the combination of the X-ray and toxine he only reported that in six cases complete disappearance of the disease was observed. I believe, that better results than this should be obtained by more powerful X-ray treatment, which could be given if no toxine were administered.

In my opinion the time to use toxine treatment, if at all, is after the X-ray has been used until the patient has received the increase in metabolism which is usually marked after from twenty or thirty exposures of X-ray of sufficient intensity and auto-intoxication has subsided.

My experience in post X-ray treatment for sarcoma is limited to eight cases, and this is certainly too small a number, to more than state that it seems to be the proper method. In one case of lympho-sarcoma, a recurrence took place while I was raying the patient. As soon as this was noticed very intense radiation was given and in six weeks no glands were palpable. The patient is still under observation and time alone can tell the end results. In this connection, I would like to report a case where the results seem brilliant from operation followed by intense radiation.

Miss A., operated upon by Dr. O. C. Gaub, July 4, 1907. The disease started over the left temple and before the patient came to Dr. Gaub the growth had been removed by another physician, and recurred, besides, the cervical glands were involved on the left side.

Dr. Gaub removed the disease below the left eye and all the structures in front of the anterior scalenus muscle except the main blood vessel and nerve, en masse down to the sterno clavicular articulation.

The pathological examination revealed a melano-sarcoma. X-ray treatment was begun the second day after the operation

and given daily for a month, and then irregularly until fifty treatments were given. The present result is gratifying, but of course time is too short to say that there will be no recurrence. The cosmetic result is excellent, as there is less scar than one could possibly conceive since the wound healed by granulation. This is due undoubtedly to absorption of scar tissue by the rays. The absorption of the scar and adhesions is always very noticeable in post X-ray work.

ENDO-ANEURYSMORRHAPHY (MATAS) IN THE TREATMENT OF TRAUMATIC ANEURYSM OF THE FEMORAL ARTERY.

BY J. M. ELDER, M.D.,

OF MONTREAL.

SINCE the publication of Matas' second article [1] on the subject of repairing wounds of blood vessels by suture, a good deal of work, experimental and clinical, has been done to test his contention that ruptured arteries could be repaired in much the same way as injuries of other hollow viscera, and, under proper conditions, with as good functional results.

In the ANNALS OF SURGERY for September, 1907, there appeared a most interesting symposium on "The Surgery of the Vascular System" by several prominent American surgeons, and as the subject of this communication is very similar to some of the cases therein cited, I have thought it would be well to publish it while the interest in the subject was still fresh in the minds of your readers.

History (Montreal General Hospital, No. 1278, S. series, 1907).–In July, 1907, a healthy lad of ten years struck his right leg against the sharp nozzle of an oil can, causing a small punctured wound just above and to the inner side of the popliteal space. The nozzle was at once withdrawn and the wound bled freely, but not furiously. The family physician, Dr. D. K. Cowley, of Granby, Quebec, saw the case and found that he could pass a probe into the wound upward, backward, and inward for a distance of two inches. The end of the probe would then be close to the position of the femoral artery in Hunter's canal. The wound was irrigated and a dry dressing applied, and it healed apparently without incident, the lad appearing to be quite well ten days after the accident.

[1] ANNALS OF SURGERY, February, 1903.

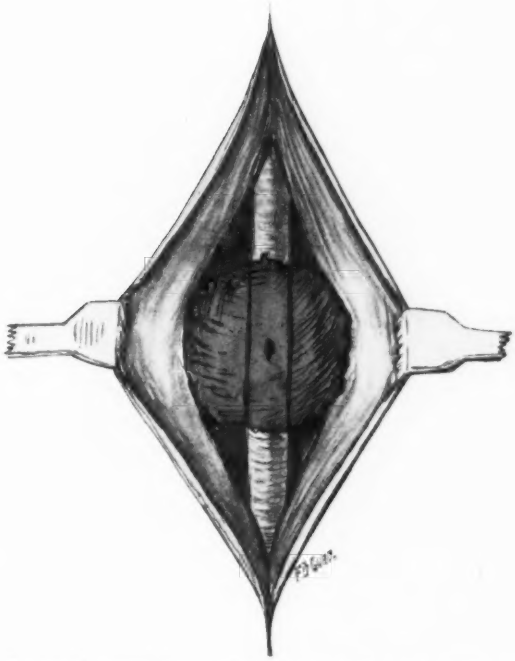
About one month later he began to complain of pain in the knee and soreness at the site of injury. His physician again examined the limb and found a tumor about the size of a Tangerine orange, situated under the scar of the former wound. The tumor was very tense and resistant (non-fluctuating) and no pulsation could be detected in it, but the stethoscope revealed a well-marked systolic bruit when placed lightly over it. The case was watched for eleven days, and it was noticed that the tumor increased rapidly in size and became softer and more fluctuating. The pain in the knee also grew steadily more severe and the lad could not extend the knee joint.

On admission to the hospital on September 11th the patient lay on the right side with right knee semi-flexed and supported on a pillow. The pulse was 84, temperature 100° F. A well-marked tumor was visible along the inner and posterior aspect of the right thigh at upper level of popliteal space. Examination confirmed the facts above noted by the family physician, and in addition there was noted much diminished pulsation in the right posterior tibial artery but no other signs of circulatory disturbance; there was local tenderness and heat over the tumor but no redness. Leucocyte count, 13,500.

A diagnosis of aneurysm was made and operation was carried out next day.

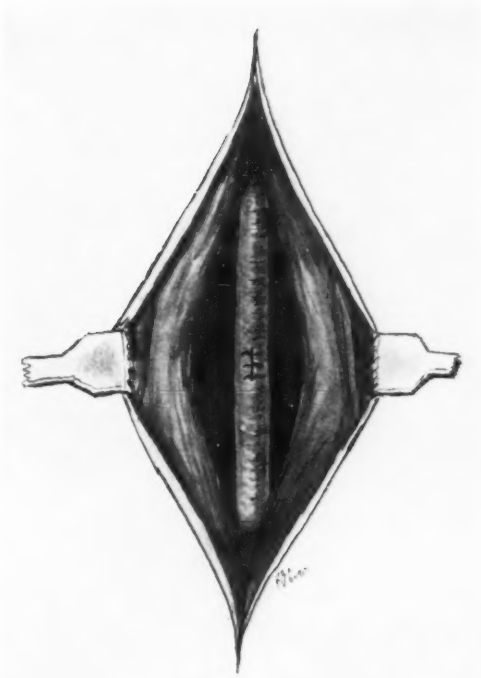
Operation.—A vertical incision, three inches long, was made over the tumor, and we at once came down upon a fluctuating swelling about the size of a Florida orange. A director introduced through the capsule showed the contents of this cyst (for such it evidently was) to be dark blood. An Esmarch was applied to the thigh higher up and all bleeding controlled. The contents of the sac, consisting of thick, dark blood-clot, were then turned out, the quantity being about four ounces. The cyst wall, or sac, was evidently composed of connective tissue only, and upon swabbing the interior the artery was seen lying at the bottom of the sac, and in the vessel wall was an oval opening measuring ½ x ¼ cm. (Fig. I). Bright red blood spurted through this opening when the tension of the Esmarch was relieved. As soon as the parts were quite dry (as Matas insists upon) this opening was closed by three sutures of fine silk, a small, round, curved needle being used and care being taken to include the intima in the sutures (Fig. II). The pressure of

FIG. 1.



Showing sac of traumatic aneurysm, with opening in the femoral artery.

FIG. 2.



Artery sutured.

the Esmarch was then taken off and the pulsations of the artery watched for a few minutes, in order to make sure that the sutures were sufficient to control all hemorrhage. The lining of the sac was irrigated with sterile water and a cigarette drain with iodoform gauze inserted down to the artery, after which the wound was closed.

The drain was removed in forty-eight hours, there being no oozing, and there followed without incident primary union of the wound. The patient left the hospital nine days after operation though still forbidden to use the limb for two weeks. There was then equal pulsation in the two tibials with no pain or swelling anywhere. Dr. Cowley has since written me that the boy is as well as ever and has absolutely no disability in the limb.

In this case one had evidently to deal with a sacciform aneurysm—really a false aneurysm, inasmuch as the sac did not consist of dilated vessel wall, but of the perivascular connective tissue. The continued stretching of this tissue would cause the pain complained of. It is likely that at the time of the accident the nozzle of the oil can had not actually pierced the wall of the artery, but had struck it with sufficient force to cause subsequent necrosis, and hence rupture of the vessel and formation of the sacciform aneurysm. As Matas, and others, point out, this is the most favorable form of aneurysm to treat by this method of suture, as one has only to close the opening to leave the vessel intact. In the fusiform (true) aneurysm, the sac would also need to be sutured or obliterated in some way, and could not be neglected as was practically done in this case.

The operation is certainly, both in its rationale and its results, much preferable to the risks of the ligature, which could always be resorted to should the suture fail.

FURTHER OBSERVATIONS ON THE TREATMENT OF PARALYTIC TALIPES CALCANEUS, BY ASTRAGALECTOMY AND BACKWARD DISPLACEMENT OF THE FOOT.*

BY ROYAL WHITMAN, M.D.,

OF NEW YORK.,

Adjunct Professor of Orthopedic Surgery in the College of Physicians and Surgeons; Associate Surgeon to the Hospital for Ruptured and Crippled.

TALIPES CALCANEUS is the most disabling of the forms of paralytic talipes because it is the result of the loss of the support and propelling force of the calf muscle. As the foot is drawn or forced constantly into dorsal flexion, the os calcis gradually assumes a more upright position, its posterior extremity becoming inferior. Thus the projection of the heel is lost and the depth of the arch is exaggerated, this characteristic cavus being more extreme in the cases in which the secondary plantar flexors retain their power which draws the fore foot backward without lifting the heel. In use the limb must be swung far forward in order to strike the heel fairly, thus straining and over-extending the weakened knee. The tissues of the heel bearing all the weight, become greatly hypertrophied, while the remainder of the foot having no essential function becomes simply an appendage to it. The disproportion between the posterior and anterior divisions of the foot, and in the size of the two feet, which is well marked even in the early cases as compared to other forms of paralytic deformity, is a striking illustration of the direct effect of impaired function on development. If one or more of the lateral muscles is paralyzed the foot is turned to one or the other side, and as the adductors are usually involved, the common deformity is valgus, so marked in extreme cases that weight is borne in part upon the inner malleolus.

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* Read before the New York Surgical Society, November 13, 1907.

In the cases of simple calcaneus, the patient in locomotion might be likened to one walking on a Pirogoff stump with the added insecurity of two uncontrolled articulations, and if lateral deformity is present the foot is rather an incumbrance than a support.

The description of the characteristic deformity (Calcaneo-Cavus) with or without lateral displacement, applies of course to those cases in which the foot has not been protected by mechanical support. The object of such support as applied in the more common forms of talipes in which the anterior muscles are involved is simply to prevent toe-drop, but in the class under consideration the brace must be strong enough to withstand the strain of locomotion, therefore so heavy as to be burdensome, and if lateral distortion is present satisfactory adjustment is very difficult. As a matter of observation it may be stated that for one reason or another mechanical treatment is ineffective in a large proportion of the cases. Thus one more often sees the extreme degrees of this deformity than of other types, among patients of the better class.

The objects of operative intervention in cases of this character are to restore symmetry and to increase the stability and the resistance of the foot, so that light and simple apparatus may be effective in all cases and unnecessary in those of the most favorable type.

Before calling attention again to the operation which was described by me six years ago (Am. Jour. Med. Sciences, Nov., 1901), which has now been thoroughly tested and somewhat improved, it may be of advantage to enumerate other procedures that have been employed, in order to illustrate by contrast its relative efficiency.

First.—Reduction of deformity by force combined with division of contracted parts. This is of course preliminary to any further procedure. It is usually ineffective in advanced cases because of the absence of resistance against which the force may be exerted.

Second.—Willett's operation of shortening the Tendo-Achillis and sewing it to the neighboring parts with the aim

of opposing the resistance of the shortened tissues to the deformity, may be of value if the calf muscle retains a portion of its power, which may act to better advantage on the shortened tendon. In other instances, if the strain of locomotion is removed by the constant use of a proper brace, the resistance may lessen the deforming influence of the muscles on the anterior aspect of the leg. From the curative standpoint, even in the sense in which the term must be used in speaking of incurable weakness, it is ineffective, and if calcaneus is complicated by lateral distortion, it is contra-indicated.

Third.—Hoffa has performed the reverse of Gleich's operation for flatfoot, namely by sawing through the posterior extremity of the os calcis and displacing it upward and backward, to restore the projection of the heel, the tendo-Achillis being shortened to the desired degree. This operation has the advantage over the last that it improves the contour of the foot in addition to shortening the tendon.

Fourth.—Tendon transplantation. It is of interest to note that this operation was first employed for the relief of calcaneus by Nicoladoni, who attached the tendons of the two peroneii muscles to the tendo-Achillis, with the aim of restoring its lost function. The futility of such a procedure is indicated by comparing the weight of the calf muscle (277 gms.) with that of the two muscles (40.5 gms.) that replace it, which are from their oblique direction subjected to still further mechanical disadvantage. Furthermore, as has been pointed out by Lorenz, the removal of the principal abductors is almost inevitably followed by varus deformity. It would appear then that the benefit of transplantation must be explained by restraint of unopposed muscular action, and that it is quite inefficient to prevent the deformity induced by functional use.

Fifth.—Arthrodesis. This operation is from the curative standpoint more hopeful than the others that have been mentioned, because firm anchylosis should prevent deformity and render bracing unnecessary. Unfortunately in childhood, when the bones are undeveloped, it is difficult to attain, even when the adjoining tarsal joints below and in front of the

ankle are included in the operation. Even firm anchylosis may not be sufficient to restrain deformity of the yielding bones during the growing period. Finally, the chances of success are lessened by deformity, especially of the lateral type. It would seem then that the operation is most likely to be successful, in those cases of simple calcaneus in adolescents in which the secondary deformity has been prevented by the use of braces.

One may sum up this criticism in the statement that each of the procedures has a certain merit in certain cases, particularly of the mild type, a class in which the brace treatment is a practicable alternative, and that the relative inefficiency of each becomes more apparent with the degree of deformity and disability. In cases of the advanced type there is no such alternative, if an operation can assure the removal of deformity and its subsequent prevention, at least as far as lateral distortion is concerned.

In the analysis of the deformity the adverse leverage of the foot must be considered. The calf muscle whose loss is the cause of the disability, in the exercise of its function, has to contract with a force four or five times as great as would be required under equal conditions, its strength according to Fick being about three times greater than of all the other leg muscles combined. This normal adverse leverage is estimated by comparing the distance from the centre of the ankle joint to the attachment of the tendo-Achillis with that of the metatarsophalangeal articulations. When the calf muscle is paralyzed the passive leverage or tendency toward deformity is increased by the loss of the projection of the heel and by the sole of the shoe which projects beyond the bearing surface of the fore foot.

The centres for abduction and adduction of the foot are the joints below and in front of the astragalus, and if one or more of the controlling muscles is paralyzed, lateral deformity follows. The insecurity caused directly by the paralysis and the distortions induced by use is exaggerated by the upright position of the os calcis which increases by at least a third the distance from the ankle to the bearing surface of the heel.

From this description of the mechanism of the deformity and of the attendant disability, it should be evident that the first step toward security must be the removal of the astragalus in order that the leg bones may rest securely on the solid part of the foot. The removal of the astragalus will permit backward displacement of the foot; thus the adverse leverage may be lessened or neutralized, while the restoration of the projection of the heel and the lowering of the malleoli to their proper level incidentally restore symmetry both as to the cavus and the lateral distortion. Further details in the operation are the adjustment of the malleoli and the tarsal bones in their new relations. The peronei tendons are usually divided and attached to the os calcis and the elongated tendo-Achillis is shortened to the required degree. The complete operation must be described as Astragalectomy and backward displacement of the foot (the essentials) combined with arthrodesis, tendon transplantation and tendon shortening, the accessories.

As this title is manifestly too cumbersome for use the procedure is usually classed under the author's name in the hospital records.

The steps of the operation are as follows: An Esmarch bandage having been applied, an incision is made from a point about one inch above the external malleolus midway between it and the tendo-Achillis, passing downward to the attachment of the tendo-Achillis, forward below the extremity of the malleolus and over the dorsum of the foot to the external surface of the head of the astragalus. The sheaths of the peronei tendons which are exposed at once, are opened throughout their entire length and the tendons, divided as far forward as the incision will permit, are thoroughly freed from all the attachments behind the malleolus and are drawn backward. One next divides the bands of the external lateral ligament, and the foot being somewhat adducted, the interosseous ligament is separated. On further inversion, the tissues being retracted, one may with scissors free the head of the astragalus from its attachments to the navicular, and forcibly twisting it outward, break off the cartilaginous margin to

which the internal and posterior ligaments that cannot be reached are attached. One then prepares the new articulation. A thin section of bone is removed from the lateral aspect of the adjoining os calcis and cuboid bones, and from the internal surface of the external malleolus, which may be further shaped to secure accurate apposition. The same, but more difficult, procedure is undertaken on the inner side. One separates the internal lateral ligament from the malleolus sufficiently to permit the complete backward displacement, then removes the cartilage from its inner surface. With the periosteal elevator the strong inferior calcaneo navicular ligament is detached sufficiently to permit the malleolus to sink in behind or to slightly overlap the navicular. Often the sustentaculum tali must be cut away to provide sufficient space for the broad, shallow internal malleolus. The two peronei tendons thoroughly freed from their attachments about the fibula are then passed through the base of the tendo-Achillis and sutured to it, and to the os calcis as well, at a sufficient tension to hold the foot in moderate plantar flexion. The tendo-Achillis is usually overlapped and sutured as an aid in restraining deformity. The Esmarch bandage is then removed, the part is thoroughly cleansed with hot saline solution, and the bleeding points are ligatured. The wound is closed with continuous catgut sutures, reinforced at several points with silk. The foot then carefully supported in its attitude of backward displacement and moderate plantar flexion with the malleoli fixed by slight pressure in their new relations, is thickly covered with sterilized sheet wadding and fixed by a light plaster bandage, particular care being taken to exert only the slightest constriction. The leg is then brought to a right angle with the thigh and the plaster bandage is continued over the thigh, reinforced by a band of steel in the popliteal region. The limb is then suspended for several days or a week, the aim being to relax tension and to lessen the oozing.

It may be noted that the essential modifications of the operation as originally described are, first, that the cartilage is no longer completely removed from all the exposed bones,

for as free motion always persisted it appeared to serve no purpose, while it increased the oozing, which if persistent interferes with rapid repair. Second, the more careful adjustment of the malleoli to their new position and the separation of the tissues attached to the internal malleolus and to the navicular bone to facilitate a complete backward displacement. Other variations have been tried, for example, lessening the thickness of the external malleolus if it appeared to project noticeably; sewing the external malleolus to the cuboid bone; splitting the tibia from below and forcing the anterior part forward to oppose a ridge of bone to the tendency to dorsal flexion. The above and like modifications are all of doubtful utility.

In cases of simple calcaneus the tendon of the tibialis posticus is sometimes transplanted to counterbalance the loss of the peronei.

The plaster bandage fixing the limb in flexion remains for several weeks until immediate repair is complete. It is then replaced by one that reaches only to the knee, holding the foot in the desired position of plantar flexion, the sole being made level by the insertion of a wedge of cork. The plaster support is worn for several months, the longer the better, since the patient must bear weight on the front of the foot until the adjustment and the formation of the new articulation are perfected.

Incidentally, the patient should be trained in the proper use of the foot, so that the equal gait may be restored. Although the cartilage is removed from the malleoli, anchylosis never follows. At best, there are fibrous adhesions that fix the parts in the improved position. The power of the transplanted muscles now exerted directly on the heel, although in no sense replacing that of the calf muscle, is sufficient under the new conditions to offset the deforming influence of the dorsal flexors, and in the absence of overstrain to hold the heel in proper position.

The after treatment will depend in great degree upon the resistance opposed to passive dorsal flexion and upon the

FIG. 1.

Talipes calcaneo-valgus during the developmental stage, showing the atrophied calf and the change in the contour of the heel. See Fig. 4.

FIG. 2.

An X-ray picture of a foot after the author's operation, showing the changed relation of the leg and foot.

FIG. 3.

The method of fixing the foot in plantar flexion after the operation, by the plaster bandage and wedge.

FIG. 4.

The foot after operation and a simple brace to be worn within the shoe. See Fig. 2.

strain to which the occupation of the patient is likely to subject the foot. In the adolescent class, if the limb is considerably shorter than its fellow, as for example, when the paralysis involves the thigh muscles, a so-called extension shoe is a satisfactory and easily adjusted support. In cases in which shortening is slight, a wedge of cork or other material within the shoe may be sufficient. Massage and proper exercises to improve the nutrition and to develop the muscles are of course of value.

In cases treated under ordinary conditions a light strong brace without joint at the ankle is worn within the shoe to hold the foot in moderate equinus. When this is rusted or broken, support is usually discarded.

In a large proportion of the cases examined for later results apparatus had not been worn, or had been discarded, yet the condition was very satisfactory. In no case was there valgus deformity. In several instances slight varus, caused apparently by transplantation of the peronei, was present, and in two cases of the dangle foot class it required correction. This would indicate that in certain cases of simple calcaneus transplantation of the tibialis posticus tendon might be of advantage. If, however, the external malleolus is forced well forward, the degree of varus can be but slight, and the cases in which valgus deformity was originally present it is rather an advantage than otherwise. In other instances the foot was habitually used in slight permanent dorsal flexion, but it was secure and symmetrical as regards prominence of the heel and depth of the arch. On the other hand, there were cases in which the muscular power was so well balanced and the gait so nearly normal as to almost merit the patient's verdict of cure. In cases in which support was used it was comfortable, easily adjusted and effective. In all cases the result was satisfactory to those immediately concerned, the improvement in the circulation of the limb and in its appearance being generally remarked.

Results such as these, obtained under the unfavorable conditions of hospital practice, should be improved in the

future by the more accurate adjustment of the parts in their new relation as in more recent cases, and still more if after-treatment and proper supervision may be assured as in the more favored class.

Talipes of the calcaneus type is comparatively uncommon and the operative method that has been described is still novel. Hoffa states, in the last edition of his text book, that he had employed it and that the results were "ausgezeichnet," but this is the only comment that has come to my notice.

As I have performed the operation in at least forty cases and have had opportunity to contrast the condition of the patients before and after treatment, I shall present and answer the criticisms that have occurred to me and which are, I assume, those that are likely to be made by others.

First.—The removal of the astragalus shortens the limb.

Second.—The operation is of a more serious character than the disability warrants, or the results justify, if a brace must still be worn to restrain deformity.

Third.—The operation may be indicated when lateral displacement is present, but it is not essential for simple calcaneus and it is not indicated when the characteristic deformity incidental to functional use (cavus) is not present.

The first objection may be answered by the statement that the removal of the astragalus is essential to the restoration of symmetry and to the attainment of security. In comparison, the slight shortening, practically never more than half an inch, is of no importance. Furthermore, the characteristic deformity of calcaneus lengthens the limb and the removal of the astragalus, which simply restores symmetry, shortens the limb only in the sense that reduction of equinus deformity shortens it; that is, if the limbs were of equal length there would be no shortening whatever. Finally, in characteristic calcaneus the fore foot is habitually above the level of the heel and plantar flexion of the foot is restricted or lost, but the space gained by the removal of the astragalus enables one to fix it in plantar flexion to the desired degree, thus to lengthen the shortened limb directly and to permit the application of the

compensating extension shoe or brace which before was impracticable.

The second question has been answered in part already, that after the correction of deformity a light and simple support may be efficient which before the operation would have been useless. The operation is, it is true, somewhat difficult and the danger would be increased by prolonged manipulation and injury of the tissues. The first should be unnecessary to one reasonably familiar with the anatomy of the part and there is no necessity for violence as no attempt need be made by wrenching, or otherwise, to change the shape of the foot; finally, the ease with which the wide wound may be drained should, in the event of infection, make the treatment simple as compared, for example, with arthrodesis. In my own experience I have not had cause for anxiety in any of the cases.

As to the third criticism. It is true, fortunately, that contrary to the rule, the operation is relatively most effective in the cases in which deformity and disability are most extreme. In my opinion, for the reasons given, it is indicated in all cases of lateral displacement and in all cases of calcaneus in which the characteristic cavus is well marked.

If deformity has been controlled by braces and if supervision and protective treatment can be assured, the operation may be deferred until the indications are clearer.

Fortunately, as has been stated, the more extreme the distortion the more satisfactory will be the result. It is this class only that surgeons are likely to encounter, and to them this operation is again presented with the assurance gained by an extended experience.

THE TROUGH-SUSPENDER FOREARM SLING.

BY W. C. WERMUTH, M.D.,

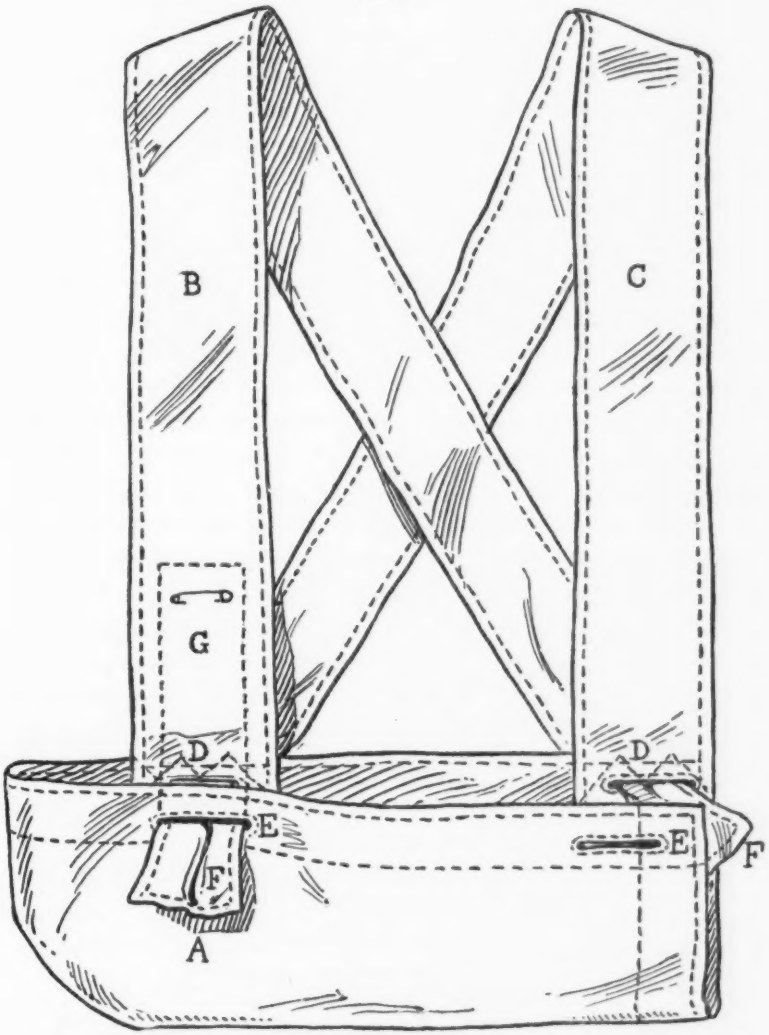
OF CHICAGO, ILL.

Surgeon to the German Hospital.

An easy, comfortable, yet efficient arm sling has ever been a desideratum in the arm sling-immobilization work of arm, clavicle and chest surgery. Surgeons are familiar with the standing inconveniences of the more or less complicated soft bandage arm sling immobilization following traumatism and operations; the inconveniences of the plaster; the discomforts of the plaster Paris bandage, its weight, excoriations, difficulties in application and reapplication; the familiar irritating pressure of the old arm sling upon the lig. nuchae and cervical tissues, especially when cervical cellulitis is present as from carbuncles, boils, sloughing glands, and other inflammatory and painful reactions. In children, it is especially difficult to obtain a secure comfortable and easy immobilization. The object of the present communication is to call attention to the advantages of a sling made in the form of a suspended trough. Though simple in form and principle, this sling is rich in security, ease and comfort. It may be made of any size. The one I describe here is of the medium size, still so far as size is concerned, any dimensions will serve, so long as proportion and principle remain the same. The sling is made of a strong muslin cloth. It is made of three pieces. The main or body piece is formed out of a square piece of such cloth, with dimensions 18 by 18 inches, once folded together, open above, sewed together at one end, rounding its lower border, giving to this body piece the form of a trough with one end open. (See figure I, A.) The open edges are reinforced by a one and a half inch hem. To the main or trough piece is sewed two suspensory slings, (B. and C.), each 42 inches long, 3½ inches wide at proximal end where they are stitched to the upper

margin of the inner or body wall of the trough piece. These slings taper to a 2½ inch wide distal end (F). The attachment of these sling pieces to the body piece, the one 3 inches from the elbow end and the other flush with the free or

FIG. 1.



The trough-suspender forearm sling. (A) Main or trough piece, receives forearm. (B) Suspender sling. (C) Suspender sling. (D) and (E) Button-holes through distal extremities (F) of suspenders pass to lock and fix sling. (G) Suspender sling end folded up and pinned for fixation.

carpal end, is likewise reinforced by an inch and a half hem. Through this reinforced attachment on each side is made an opening (D), a buttonhole, also reinforced and large enough to pass the distal extremity of the suspensory sling. Likewise in the upper margin of the outer wall of the body piece, two buttonholes are made (E) directly opposite the former two to receive these distal ends. The distal (F) ends pass through the buttonholes of the walls of the trough piece and drawn taut as occasion demands securely lock and fix the arm sling. Illustrations show the forearm at right angles. Should occasion demand any other angle, the inclination or declination can be changed by shortening the pin fixation (G) on the one sling and elongating that of the other side to corresponding degree. By reversing or turning the body piece of the sling inside out, it adapts itself to either side of the body, viz., so that the suspender sling wall is in juxtaposition with the body.

Application.—Following the dressing appropriate to the injury of the part, whether of traumatic or operative nature, the forearm is placed in the body piece of the sling, so that the elbow approximates the closed end of the trough. Then, each suspensory sling is raised over the corresponding shoulder. (See figures I and II.) Next, they are brought down crossing each other in typical suspender fashion over the back of the chest, that each distal end may pass down to and through the buttonhole of the other side. (See figure III); the end further passed through the buttonhole on the other wall of the trough and the suspenders drawn taut, the arm sling is thus locked and made firm. The ends of the suspenders are folded up against and pinned to the suspender of the proximal side (G). This fixes the sling, giving it a firm purchase without discomforts of any nature, prevents swaying or other undue or inconvenient motion. In children, this solidity of fixation proves of inestimable advantage, in securing against the annoyances and dangers of escaping parts. Instead of pins in the first models, buttons were used, but the buttons were discarded because of

FIG. 2.

Anterior view of arm sling applied to a case of foot-ball fracture of the clavicle and Colles' fracture of the wrist. Shows easy riding sling; simple compress pad over site of fracture of clavicle.

FIG. 3.

Posterior view of arm sling, shows easy and firm purchase of both trough and suspender pieces.

possibility of infection. The application of the sling is simple, easy of manipulation, without complications, painless and secure. It can be applied and reapplied, its angles changed and rechanged without pain or discomfort.

Uses.—As an arm sling, wherever such immobilization is desired, as in fractures, dislocations of the arm, forearm, hand and chest; after burns, wounds or operations, for inflammations or neoplasms; following operations for correction of outline or development; in fractures of the clavicle a good dressing is formed by simply introducing a compress pad under the suspender sling of the affected side. (See figure II.)

In its use there is no dragging from weight of material; no distressing excoriation from plaster, skin or weather; no tenderness or soreness of tissue; the easy adaptability of the sling so as to overcome non-neutralization of opposing muscular activities, brings about a painless and perfect muscular and tissue repose.

PARTIAL RESECTION OF UPPER AND LOWER MAXILLÆ FOR CONGENITAL DEFORMITY OF THE FACE.

BY ROBERT T. MORRIS, M.D.,

OF NEW YORK,

Professor of Surgery in the New York Post-Graduate Medical School.

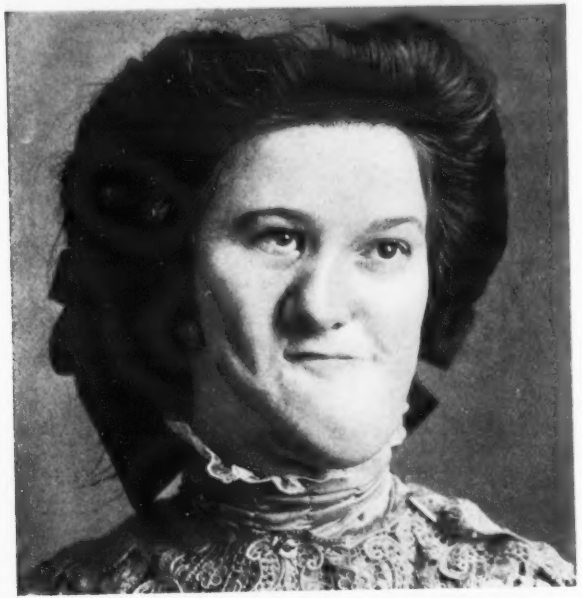
Miss H. L. F., 22 years of age, came under my care at the Post-Graduate Hospital in New York, on November 22, 1905. Figure 1, from a photograph taken before operation, gives a general idea of the facial deformity. The photographer was not given special instructions, and obtained artistic effects, partially disguising the prognathous mandible, and leaving the deformed ears hidden. A detailed description of the deformities with a view to accuracy of report, would make tedious reading, and I will give salient points only.

The left superior maxilla was hypertrophic, and the right superior maxilla was atrophic. Teeth irregularly disposed. Nasal and lachrymal bones, vomer and vertical plate of the ethmoid bone had adapted themselves in development to correspond with the deformities of the superior maxillæ.

Mandible markedly hypertrophic and prognathous, projecting more than an inch in advance of its normal frontal line, making speech difficult and closure of the mouth impossible. Left mandibular body larger than the right one, and both of them about double normal breadth and thickness. Teeth irregularly disposed. The tip of the large nose was fairly below the right orbit, and the tip of the bulky chin was fairly below the left orbit. The external ears consisted of little more than concha, antihelix and lobe, and they stood out at right angles to the head.

First Operation.—Preliminary tracheotomy, for anesthesia, and to allow packing of the pharynx. Incision within the mouth along alveolar border. Soft parts separated from the superior maxillæ, with care to avoid injury of the lachrymal ducts. Vomer cut away from the hard palate with a thin sharp chisel. Larger part of the left superior maxilla, including part of the orbital plate and alveolus with several teeth, removed with the chisel.

FIG. 1.



Congenital deformity of the bones of the face.

FIG. 2.

Showing result after partial resection of upper and lower jaws.

A small external opening at the root of the nose allowed entrance of a narrow chisel that was used for loosening the nasal and lachrymal attachments. The loosened nose structures were then swung into the space previously occupied by the left maxillary sinus, and held in place with compresses. One week later it was thought best to remove a little more of the orbital plate (operating through the mouth). Healing of the extensive wound surfaces occurred without special incident.

Second Operation.—A segment of mandible fully three inches in length and carrying several teeth was excised. The segment included the symphysis menti, and considerable more of the right body than of the left one. Excision of the segment was begun with Gigli saws but completed with the chisel, as the hypertrophic bone was eburnated and it broke the saws. The remaining portions of mandible were brought together in the middle line and sutured with silver wire. This operation, like the first one, was done within the mouth. Repair was conducted without complications. The second part of the operation carried the point of the chin to the middle line of the face and in good line with the nose. The ponderous mass of soft tissues composing the chin and lower lip did not contract enough to give symmetry of contour to the face, and about six months later I cut out the superfluous soft parts and managed to shape the lip and chin rather prettily. At the same time the protruding ears were set back by the method which we commonly employ for protuberant ears. A segment of skin and cartilage was removed from the posterior part of each ear, and the cut surface was made to fit against a corresponding area above each mastoid process. The operative work in this case has resulted in giving excellent facial lines. The mouth can be closed normally, and improvement of speech began very soon after the removal of the segment of hypertrophic mandible. Figure 2, from a second photograph taken recently, gives a good view of the present condition of face structures.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, November 13, 1907.

The President, Dr. George Woolsey, in the Chair.

EXCISION OF THE RECTUM FOR CARCINOMA.

Dr. Charles H. Peck presented two patients:

Case I—*Combined Abdominal and Perineal Route.*—A man, 28 years old, had complained of gradually increasing constipation, with pain in the rectum and occasionally blood and mucus in the stools, for about four months. He gave no specific history, but had been put through a thorough course of treatment with potassium iodide without improvement, and subsequently a specimen taken from the growth for examination was reported to be adenocarcinoma. When the patient was first seen by Dr. Peck in June, 1907, there was a tight stricture of the rectum, the lower end of which was three or four inches from the anus. It was densely indurated, too tight to admit the finger, and somewhat fixed anteriorly.

The pain, discomfort and loss of weight had been increasing steadily, and the patient insisted upon having an operation performed in spite of the fact that the risk and uncertainty of outcome were explained to him very frankly. On July 1, 1907, under ether, the abdomen was opened by a vertical incision through the left rectus, and the patient placed in the high Trendelenburg position. The growth was felt low in the pelvis, somewhat attached to the base of the bladder in front, but otherwise free. The lymph nodes in the meso-rectum were enlarged.

The rectum was divided with a cautery between two clamps well above the growth, at the level of the promonotory of the sacrum. Each cut end was closed with a continuous suture of heavy catgut, a heavy silk purse-string suture and a silk Lembert

stitch. The superior hemorrhoidal vessels were ligated and divided, the peritoneum at the base of the meso-rectum on either side incised, and the rectum, together with enlarged glands, freed from the hollow of the sacrum nearly to its tip. Laterally, it was freed to the base of the bladder on either side, and the middle hemorrhoidal vessels were ligated, but anteriorly the growth was close to the base of the bladder and sufficient exposure could not be obtained to separate it from above. The abdominal wound was padded off, the patient placed in the lithotomy position, and after dilating the sphincter, cleansing, and closing the anus with a heavy silk purse-string suture, a median posterior incision was made and the coccyx excised. The levator ani was divided, the hand passed up into the pelvis along the hollow of the sacrum, and the closed end of the lower segment drawn out through the perineal wound. Separation from the bladder and prostate in front was now completed, and transverse division below the growth just above the internal sphincter effected. The remaining mucous membrane of the anal segment was then excised, the closed proximal end of the gut was drawn down through the sphincter and secured by heavy silk sutures to the anal margin. The sutures were passed deeply into the muscular coat, around the purse string and Lembert sutures, which were left in place, the gut not being opened. Only moderate division of the peritoneal layers of the meso-signoid was necessary to allow the closed end of the gut to be brought down within the sphincter without tension. The perineal wound was then closed with deep catgut sutures, several of which caught the wall of the gut for additional anchorage, except at the upper angle, where a large rubber covered gauze drain was carried to the hollow of the sacrum. The skin was closed with continuous silk. Returning to the abdominal wound, the peritoneum on either side and at the base of the bladder was sutured to the gut wall with catgut, closing off the peritoneal cavity completely from the wound area. The abdominal wound was then closed without drainage.

The operation took two hours and forty minutes; hemorrhage was moderate throughout, but there was some operative shock and an infusion of 1500 c.c. was given on the table.

The segment of gut removed, in the fresh state, measured about six inches, in the centre of which was a dense cartilaginous

ring of tumor tissue reducing the lumen to the size of the little finger. There were several hard, enlarged glands in the meso-rectum.

The purse-string suture closing the gut was not disturbed until the sixth day, when it was removed and a tube was inserted into the gut. On the eighth day there was a good movement of the bowels through the sphincter. The patient was out of bed on the twenty-first day, with the wound healing kindly, and no fecal fistula, all matter from the bowel passing through the sphincter. He has continued to improve and has a moderate degree of sphincter control.

CASE II—*Perineal Route.*—The patient was a woman, 45 years old, who had suffered gradually increasing difficulty in emptying the rectum, with pain and bleeding, for about seven months. Her symptoms were for a time attributed to hemorrhoids. Upon admission to Roosevelt Hospital on July 17, 1907, there was an indurated, ulcerated growth involving the anal segment, extending from the muco-cutaneous junction upward for about two inches. The posterior commissure and lower portion of the posterior vaginal wall were involved in the growth. The microscopic report on a specimen removed a week prior to her admission was adeno-carcinoma.

Operation was performed July 19, 1907, under ether anesthesia. After closing the anus with a purse-string suture of heavy silk, an ovoid incision was made from the coccyx forward, including the anus, posterior vulvar commissure and lower third of the posterior vaginal wall, as well as a wide margin of skin on either side.

The levatores ani were divided, the vaginal wall separated, and the rectum freed and drawn down until a healthy portion well above the growth was reached. A small wound in the peritoneum of Douglas' cul-de-sac was closed with catgut sutures. The gut was divided transversely about three and one-half inches from the anal margin and the edges of the proximal segment were sutured to the skin of the perineum with heavy silk. Plastic closure of the wound anteriorly, as in complete perineorrhaphy was then effected, and a cigarette drain posteriorly to the hollow of the sacrum. A rectal tube wrapped with gauze was placed in the gut. The operation took an hour and a half, and was well borne.

The bowels were not moved until the eighth day after the operation. The perineal repair healed by primary union, and at the end of two weeks the wound was entirely healed except for a narrow granulating area surrounding the new anus, where the mucous membrane had retracted slightly from the skin.

A noteworthy feature of the result is that in spite of the fact that the sphincter muscle was entirely removed with the growth, the patient regularly goes two or three days between each defecation, then takes a cathartic, and has one or two movements followed by another interval of comfort and freedom from soiling. She is able to attend to her household duties and usual occupations to an extent not anticipated at the time of the operation.

The result in the two cases presented, in one of which there is no possibility of even partial sphincter control, is suggestive of the importance of the trap-like action of the sigmoid loop if its normal mobility has not been interfered with by a previous colostomy, for the degree of comfort attained by both cases could hardly be improved upon.

Dr. Willy Meyer said he first wished to emphasize the wisdom of adhering to the principle of avoiding an artificial anus in these cases if possible. Whether this was feasible or not depended principally on the degree of the stricture we had to deal with. If we succeeded, in the course of eight or ten days, by means of repeated doses of castor oil, and possibly high rectal enemata, in emptying the intestinal tract fully, it was of great advantage to these patients to avoid the formation of an artificial anus, which at best required three operations in the case. The speaker said that in his own cases operated on by this method during the past ten years, the results had been very satisfactory. He could not recall a single instance where, after a thorough preparation of the patient, including a restricted diet, a large amount of fecal matter came down to disturb the results of the operation.

The speaker referred to the difficulty in some of these cases of removing the glands in the meso-colon, upon which the future fate of the patient might depend. In order to gain a good access to the field of operation, Dr. Meyer said that at the German Hospital they had adhered to the posture which was introduced there by Dr. F. Lange about twenty years ago, namely, the knee-chest

posture, with a heavy pillow under the patient's abdomen to relieve the negative pressure. In this position the work was immensely facilitated, and it revealed a good view of the rectum and sigmoid. He usually made a wide incision into the peritoneum, and then followed by means of the double ligature the gut up to the meso-sigmoid, making it as movable as possible. He had been amazed in a number of instances to see how far-reaching ligation of the meso-sigmoid was possible in order to render the sigmoid movable and yet not get subsequent gangrene. He had never seen gangrene of the end of the sigmoid occur, except after Witzel's operation, when the gut is pulled through a lateral incision.

The speaker emphasized the importance of safely securing the cut ends of the gut. It was attention to this that rendered the operation aseptic. A method he had followed was to divide the muscular coat of the rectum down to the mucous membrane, being very careful not to open the latter, and then tie the mucous membrane tightly with an ordinary ligature; then dividing the rectum between the clamp and ligature, and leaving it to nature to let the ligature cut through. This process usually required three or four days, and by that time the danger of infection had passed.

Dr. Andrew J. McCosh said the excellent results obtained by Dr. Peck in the two cases shown should rather encourage surgeons to perform more frequently radical operations for cancer of the rectum. On account of the bad results that had been reported, fewer of these radical operations were probably done at the present day than were done ten years ago. In spite of that, quite a goodly number of cases that had remained cured for five years or longer could probably be placed on record by various members of the Society.

Dr. McCosh said that in his own practice he had never resorted to a preliminary inguinal colostomy in these cases, nor could he see any necessity for or advantage in doing so. The results, so far as cleanliness was concerned, which followed complete extirpation of the rectum after the sphincter muscle had been entirely removed, were as a rule rather disappointing and disagreeable. Still, he recalled one case where that operation was done fifteen years ago, the entire rectum being extirpated, together with the sphincter muscle, and the patient seemed per-

fectly satisfied with the result and was able to keep himself comparatively clean. His practice was to wash himself out in the morning, and there was very little leakage during the rest of the day. He also recalled the case of a woman upon whom he did the original operation about twelve years ago, and subsequently showed at a meeting of this Society. In that case an extensive excision of the rectum had been made through an abdominal incision, preserving the sphincteric part of the rectum, perhaps an inch and a half of the mucous membrane being left. The gut was not pulled down but was sutured to the edges of the abdominal wound, an inguinal colostomy. The patient was not satisfied with her colostomy wound, and as more than three years had elapsed since the original operation, the danger of a relapse being comparatively slight, a second operation was undertaken. The section of the gut that was attached to the inguinal opening was brought down and stitched to the remaining segment of the rectum at the anus. At the time of the operation the woman weighed 280 pounds; she now weighed 350 pounds and still remained entirely well, the result of the second operation being perfect.

The speaker said that in the last three cases where he had excised the rectum and had also found it necessary to excise the sphincter, he had not brought the end of the gut down to the gluteal region at all, but had fastened it in the inguinal region, bringing perhaps five or six inches of the gut well out through the abdominal incision and passed for this distance between the internal and external oblique muscles and fastened well outside of and below the anterior superior spine of the ileum. Two of these patients who were still under his observation were able to keep themselves remarkably clean by wearing a broad pad which effectually compressed the section of gut which lay between the internal and external oblique muscles. One of them, who was operated on three years ago, was an actress who was still on the stage. She washed herself out every morning with glycerine and water and remained dry until the next morning. There was practically no leakage.

Dr. McCosh said that he could recall at least four cases where he could claim a radical cure after excision of the rectum for cancer. One of these was done fifteen years ago, another twelve, a third nine, and the last about five years ago.

Dr. L. W. Hotchkiss said he had operated upon one case of carcinoma of the rectum during the summer in which a preliminary colostomy was done for the intestinal obstruction. After the obstruction was relieved, a resection of the rectum was done for a growth which was high up in the rectum and leaving several inches of gut intact above the sphincter. In this case the approach was made by the osteoplastic sacral flap of Rydygier. The peritoneal cavity was opened, the growth was freed and the gut was brought down and resected; but by reason of the preliminary colostomy the upper segment was too short to make a comfortable telescopic anastomosis, so an end-to-end suture was resorted to. In this case the posterior wall of the proximal end of the gut had sloughed, necessitating its subsequent removal and the establishment of a permanent artificial anus through the abdominal wall.

As regarded the radical cure of cancer of the rectum, Dr. Hotchkiss said he could report one case in a man 54 years old who was still alive and well over five years after a resection of gut for the removal of a high soft rectal carcinoma. The removal was made through Rydygier's perineal incision, and the patient had good control of the sphincter which had been preserved.

In extensive cases of cancer of the rectum, the speaker said he thought there was no doubt about the propriety of doing a complete removal of the lower end of the gut through the combined abdominal and perineal operation and establishing a permanent abdominal artificial anus above. Personally, he had obtained the best results in cases where the sacral operation by the osteoplastic method of Rydygier had been possible, although he was well aware that resection with preservation of the lower segment of the rectum with the sphincter was only allowable in selected cases.

Dr. George Woolsey said that while he was formerly in favor of a preliminary colostomy in suitable cases, he now preferred to make an opening in the inguinal region and establish a permanent fistula.

Dr. Peck, in closing, said it had occurred to him that in cases where no preliminary colostomy was done, and where the mobility of the sigmoid loop was not interfered with, the latter apparently had some influence in keeping these patients from soiling themselves.

SYNCHRONOUS LEFT URETEROSTOMY AND RIGHT NEPHROSTOMY FOR HYDRONEPHROSIS DUE TO URETER OBSTRUCTION BY BLADDER TUMOR. PERMANENT DRAINAGE.

DR. F. TILDEN BROWN presented a man, twenty-three years of age, who six years ago had an attack of measles, and since then, at periods of from three to four months, he had had attacks of pain in the bladder, perineum and penis; these lasted two or three hours and were relieved by a warm bath. He was examined by physicians in Germany for admission to the Army, and was said to have had pulmonary tuberculosis. After treatment he was pronounced cured, and he had had no pulmonary symptoms since that time. His family history was negative. He gave no venereal history. All subsequent observation supports this negation.

On April 16, 1907, without previous symptoms, he was suddenly awakened by a severe suprapubic and perineal pain radiating to the tip of the penis. Urination was very difficult and accompanied by much blood. The pain was severe and persistent, requiring hypodermics of morphine. When he was admitted to the Presbyterian Hospital, on the same day, he was still having severe pain and was passing small amounts of bloody urine, voluntarily and involuntarily. A catheter was introduced and twenty ounces of bloody urine withdrawn. Examinations for stone and X-ray exploration of the kidneys and bladder were negative.

Repeated tests for tuberculosis of the genito-urinary tract were negative. Physical examination showed tenderness and rigidity over the bladder region. The prostate, by rectal examination, appeared normal, except at its upper limits and the tissues beyond.

Three days after admission the patient had a similar attack, with pain referred to the tip of the penis, and followed by bloody urine. Four days later, a more thorough examination revealed a larger mass per rectum; it was just above the prostate, hard, irregular and tender, seemingly involving the posterior bladder wall and seminal vesicles. A cystoscopic examination, made by Drs. McWilliams and Osgood, showed a large sessile hemispherical tumor, with an irregular and ulcerated surface, involving the base of the bladder, encroaching upon the ureters, especially

the left, and extending to the lateral aspects of the bladder. The patient's general condition grew worse; his pain was more severe, radiating down the thighs and most marked in the flanks in each kidney and ureter region. It was evident that both ureters were at times obstructed, and that this intermittent hydronephrosis was the cause of principal suffering. An operation for its relief, and in anticipation of a subsequent radical operation on the bladder, was offered, wherein a renal outlet would be provided for in each ilio-costal space.

On April 27, 1907, with the patient prone on the face and large supports under the abdomen to lift and extend the loins, the left kidney and ureter were exposed, and the latter was ligated and cut and stripped from its peritoneal attachment five inches below the kidney. The severed ureter was then brought to the surface and fastened by means of chromic sutures to the skin. A small soft rubber catheter was inserted to the renal pelvis and secured to insure drainage and prevent the wound from becoming soiled. The wound was then sutured and a superficial cigarette drain inserted.

The right kidney was then operated on. Here the ureter was left intact, and a nephrostomy done by blunt scissors passed into the pelvis through the cortex and parenchyma from the convex border just below its middle. An angled, soft rubber catheter was pushed through this kidney wound into its pelvis for drainage. About two weeks after the operation there was a profuse discharge of most offensive necrotic material from the bladder through the urethra, and the tumor previously felt by rectum seemed smaller but still with resisting, undulating wall. Irrigation of the bladder gave evidence of extensive breaking down of tissue. From the first, and ever since, the drainage from the left kidney has been more satisfactory than that from the right, *i.e.*, the side on which the catheter entered the renal pelvis through part of the ureter. For four or five weeks some of the right kidney urine found exit through the ureter, bladder and urethra; subsequently all drainage ceased by the bladder and the urine was drained through the nephrostomy wound by means of the right-angled catheter, held in place by adhesive, and led into one of the two bottles suspended on the flanks from the shoulder. Later, the bottles were suspended in front, just above the groin by means of a sling about the neck. This

again was subsequently improved by using a long rubber receptacle suspended from the pubic region and worn inside the leg of the trousers, to the top of which was fitted a hard-rubber nut into which was screwed a metal Y-shaped tube to the upper branches of which the catheters were attached. This apparatus perfected and adjusted by Dr. Keator was suspended by webbing from the neck and held to the body by a belt of the same material about the hips. The drainage was perfect, and management of the single large urinal was much easier for the wearer than any of the former devices. At night the patient connects each catheter with a short tube entering a bottle on each side of the bed. The bed clothes are not even moistened by any leakage. No urine is passed by the bladder. The catheters are removed every second day, and fresh sterilized ones inserted.

A cystoscopic examination, made on July 21, 1907, showed that the bladder would tolerate only two ounces of fluid, greater distention was very painful, and a complete disappearance was noted of the tumor previously seen. There was no ulceration, but outside of the left ureteral orifice there was a dark area of depression, suggesting the former site of part of the tumor. The left ureteral mouth looked normal. The right one was surrounded by a slight hyperemic and elevated zone, and there were several places on the base of the bladder which suggested small healed ulcers. A rectal examination showed some thickening of the bladder floor above the prostate. The patient is now in good health; he has gained in weight, and has had no discomfort from the apparatus excepting that incidental to the dressings.

There remain several interesting considerations in the future management of this case, the most important being a diversion of the right kidney urine to the bladder again, through the intact right ureter, and closure of the nephrostomy sinus. The fact that the etiology and exact point of origin of the tumor are still undetermined makes it seem advisable to defer yet awhile any change from the existing satisfactory condition. But in anticipation of this restitution of normal right side urinary functions, vesical irrigations have been commenced with the hope that distensibility and contractility of this viscus may be regained and ready to be utilized.

In this patient as with a former case of nephrostomy it was found that the only certain way to determine with an instrument

that the renal pelvis was accurately occupied by the drainage catheter was to slit the ureter near the pelvis for insertion of delicate curved forceps which was then pushed through pelvis or central calyx and on through parenchyma and cortex here to grasp the catheter and draw it back into the pelvis. Removing forceps to suture the ureteral slit. The kidneys in these nephrostomy cases are apt to have normal pelves, small, collapsed envelope-like spaces, gaining an instrumental entrance to which from the surface of the kidney is fraught with uncertainty. The instrument is as apt to bring up at the hilum *outside* the pelvis walls, as *between* these two closely opposed surfaces. The finger, of course, might be a reliable guide, but kidney puncture by so large an object is unnecessarily damaging.

TUBERCULOSIS OF THE TESTIS.

Dr. F. Tilden Brown presented a man, 34 years old, a machinist by occupation. His immediate family history was good, but four of his uncles had died of pulmonary tuberculosis. He had formerly used alcohol to excess. When he was nine years old he had an attack of hematuria lasting one day, for which no cause could be assigned. About that time he was said to have had repeated attacks of malaria. When he was thirteen years old he began to lose flesh, and developed a cough, with bloody expectoration. He was sent to the country for four months, where he gained decidedly in weight and strength.

Ten years ago the left testicle became swollen, red and painful. Within a month it broke down and discharged, the sinus healing in three months without any treatment. The testis, however, still remained swollen and tender, and three months later it broke down again. At that time the patient was having frequent nightsweats; he felt weak and was losing weight. The testis was curetted with good result.

On August 15, 1907, "after a heavy lift," the right testis became swollen, but not painful. It was five inches in length and three and a half inches in diameter. It subsequently broke down and discharged, leaving a circular ulcer. The patient still had nightsweats at irregular intervals. He was admitted to Bellevue Hospital on October 8, 1907. His temperature at that time varied but little from the normal. The main interest then was a differential diagnosis between gummatous, cancerous, tuberculous ulcer

and ulcer due to chronic localized urinous infiltration. While the history and state of the contained organs was almost enough in itself to justify the diagnosis of tuberculous ulcer of the scrotum secondary to that of the epididymis and testis, the appearance, unusual size and hard induration of the margins was much more suggestive of epithelioma. As had been his experience in the majority of such cases, tubercle bacilli were readily found in the discharge.

Operation.—A complete removal of all the tissue involved, guarding against any chance of soiling the new surface, was aimed at. The testis was pretty completely infiltrated, but with a later development of tuberculosis than that in the epididymis. The vas was not involved at the point of severing the cord.

FURTHER OBSERVATIONS ON THE TREATMENT OF PARALYTIC TALIPES CALCANEUS BY ASTRAGALECTOMY AND BACKWARD DISPLACEMENT OF THE FOOT.

Dr. Royal Whitman read a paper with the above title for which see page 264.

In connection with his paper, Dr. Whitman presented a number of patients upon whom he had performed this operation.

Dr. F. Tilden Brown said that the theory upon which Dr. Whitman had based his operation appeared to him as wise. The speaker said that some years ago he was impressed with the comparatively insignificant functional importance of the astragalus by the case of a young man who was thrown from his horse, receiving a severe injury of the lower leg, including a Pott's fracture and a dislocation of the astragalus. Dr. McBurney urged removal of the bone. This resulted in scarcely noticeable shortening. The patient made an excellent functional recovery, and in comparatively short time was able to play tennis, ride, and dance about as well as before.

Dr. Woolsey said the cases demonstrated by Dr. Whitman were certainly excellent, especially when we had in mind the severe type of deformity from which these patients had suffered. It was remarkable with what impunity the astragalus could be handled. The speaker said he had removed the bone several times to correct the deformity resulting from equinovarus, but he had never done the operation in talipes calcaneus.

DOUBLE CASTRATION FOR TUBERCULOSIS.

Dr. John A. Hartwell showed specimens removed from a boy, aged seventeen years, Italian, who was admitted to Bellevue Hospital on July 18, 1907, with a well-advanced tubercular disease of the elbow. This was operated on by Dr. Hitzrot, a radical resection being done. The post-operative progress was slow, but satisfactory until about September 1st. At this time the reparative process came to a standstill and the soft tissues in the neighborhood of the joint began to break down with tubercular infection. At the same time his general condition began to fail. On September 6th all the tubercular disease was curetted out by Dr. Hartwell and the cavities drained. The patient was then put on treatment with bacillen emulsion Koch, made by killing the tubercular bacilli by heat, grinding them in a mortar and making a watery suspension of them. He received the following dosage, expressed in weight of the powdered bacilli: September 6th, 1–5000 milligram; September 11th, 1–5000 milligram. This gave no local or general reaction. September 17th, 1–2000 milligram, producing a considerable reaction, rise of temperature, and general malaise. September 20th, 1–2000 milligram, with again marked reaction. Following this last injection he complained of pain in the left testicle, examination of which showed it very much swelled, tender and adherent to the skin, both testicle and epididymis being involved. Careful questioning failed to elicit any knowledge on the part of the patient of any previous diseased condition of the organ. It was apparent, however, that it was the seat of a well-advanced tubercular process. Accordingly on September 21st castration was done by Dr. Hartwell, the incision being extended up through the whole length of the inguinal canal. The vas was then found to be diseased throughout its whole length, as was also the seminal vesicle. Incision was therefore enlarged upward, the deep epigastric vessels tied and cut, and the anterior sheath of the rectus freely incised transversely. The traction of the wound thus made gave ample exposure for the removal of the whole of the vas and the vesicle. Palpation through the bottom of this wound showed the prostate and opposite vesicle to be involved. The right testicle and vas, however, were apparently free from any involvement. The post-operative course was very satisfactory, the deep wound healing very rapidly. On

October 12th he received 1–50,000 milligram of the emulsion, and on October 15th 1–25,000 milligram. This was followed by marked reaction and swelling in right testicle. Rest in bed, strapping and local treatment had no effect on this local inflammation. Accordingly, on November 5th, the above operation was repeated on the right side by Drs. Dennis and Hitzrot. An examination of the specimens removed showed the following conditions: Left testicle, epididymis, vas and seminal vesicle are all the seat of advanced tuberculosis with extensive caseation. The right organs show a much less marked process in the vas and testicle, but an exactly similar condition in the vesicle. The condition in the left testicle was very evidently an old affair which was apparently started into renewed activity by the vaccine treatment. It will be noted, however, that on September 17th the dose of 1–2000 milligram gave a strong reaction, and that this was followed on September 20th, before the reaction had subsided, by the same dosage. This was an error inasmuch as overdosing with the vaccines is known to be harmful. In the case of the right testicular involvement, the dosage was more carefully regulated, and still the marked reaction occurred and persisted. It would seem, therefore, that the bacillen emulsion must be used with extreme caution, to avoid the harmful lighting up of quiescent processes. In spite of the setbacks the boy received, his general and local processes both in the elbow and in the genital tract seemed to be much improved by the use of the vaccine. Dr. Hartwell presented the specimens as a matter of record in the vaccine treatment of surgical tuberculosis, and also as a matter of interest which they afforded in the case with which vesiculectomy may be done through an inguinal incision. He wishes to express his appreciation of the courtesy of Drs. Dennis and Hitzrot in putting their notes of the case at his disposal.

Dr. Willy Meyer said that while in a case like the one reported by Dr. Hartwell, where the testis and vas and seminal vesicle were involved, a thorough operation like the one performed was clearly indicated, he wished to call attention to a more conservative method of treatment in cases where one testis had been removed for tuberculosis and the second subsequently became diseased. With no involvement of the prostate or vas deferens we had a clear ascending tuberculosis of the genital tract, and in those cases, especially in younger patients, Dr. Meyer said

he wished to say a word in favor of Bier's hyperemic treatment. He recalled the case of a young man of nineteen who about ten years ago had one testis extirpated for tuberculosis; the second organ subsequently became involved, and the patient begged to retain it, if possible. Bier's hyperemic method of treatment was instituted and faithfully carried out for a long time, and now he was cured so far as the tuberculosis was concerned, although the epididymis was still slightly enlarged. Quite a number of such cases were on record. This case was shown before this society about six to eight years ago. The treatment, which could be carried out by the patients themselves, was indicated in those cases where the one remaining testicle became affected by tuberculosis.

KIDNEY BOARD AND ARM GALLOWS.

Dr. F. Tilden Brown demonstrated a later model in thin steel of a huge hinge, which was shown a year ago when made as a folding wooden board. The purpose of the apparatus is that of making a good surgical exposure of the ileo-costal space in kidney operations, when placed under the opposite region, where its degree of elevation is controlled by crank. In operations on gall-ducts and bladder also, its easy introduction under the dorsal spine makes it useful.

Dr. Brown also showed an adjustable gallows for slinging the superimposed arm when the patient is on the side. Relieving the chest of the shoulder and arm weight, besides favoring comfortable anesthetization, it serves as a prop to prevent the patient's thorax and trunk twisting forward.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated meeting held November 4, 1907.

ESOPHAGOTOMY FOR IMPACTED COIN IN A NINETEEN MONTHS OLD INFANT.

DR. CHAS. F. NASSAU presented a child who had been referred to him by Dr. Bridgett of West Philadelphia, on account of a suspicion that the child had swallowed a five-cent piece. She was not particularly ill for a while, but she could take only liquid food, even soft potato being vomited. Shortly the child had a quite serious gastro-intestinal upset, as it was supposed. When she was finally brought to Dr. Nassau he had an X-ray plate made, which showed the nickel piece lodged in the esophagus just above the suprasternal notch. On the following day, the twelfth after the swallowing of the nickel the child was admitted to St. Joseph's Hospital. Dr. Nassau passed esophageal forceps readily down the esophagus and could feel them strike a metallic object, but he was not able, with some little pains, to grasp this object. Considering the length of time this foreign body had been imbedded in the child's esophagus he thought it wisest to do an esophagotomy rather than try to force the nickel out. The operation consumed but fourteen minutes, and there was little trouble about the operation. There were no vessels requiring ligation; the wound was closed after the introduction of a gauze drain, without suturing the esophagus. The nickel lay in the anterior portion of the esophagus with the edge turned up a little toward the left and spanning it tightly, as though in a pocket. There was no leakage of either fluids or food and the child made a perfectly uninterrupted recovery.

Dr. Nassau also referred to a second recent case. The patient, a physician, swallowed a set of caps and pivot teeth at

3 A.M., and the operation was performed at about 9.30 following, there being no question about attempting to remove them by any other method. The patient had a rather stoutish neck which it was impossible to stretch out quite as desired. The operation was performed in a country house and took about twenty minutes. This esophagus was sutured and the entire lower half of the wound was drained. The pack was inserted for about 4½ inches, which Dr. Nassau afterwards considered extremely wise as the wound was badly infected within two days. This wound is now very well cleaned up, there being healthy granulation and no leakage. Any kind of liquid food can be swallowed without pain.

DR. WILLIAM J. TAYLOR stated that in 1900 he operated upon a child of 16 months who had swallowed a good sized metal clip. This was in the child's throat for seven months. It was a nursing baby and therefore had swallowed its milk fairly well, but it was absolutely impossible for it to swallow solid food. An X-ray picture was taken soon after the swallowing occurred but unfortunately the child was not etherized and the plate was a failure. When the child was referred to Dr. Taylor he had Dr. Leonard take a skiagraph, which gave a most excellent view of this clip which was open. The child was etherized, and but slight efforts were made to reach the object with instruments. Dr. Taylor agrees with Dr. Nassau that the only safe plan when foreign bodies have been in the esophagus a long time is to do an esophagotomy. This was done in his case and the child made a very satisfactory recovery and is now a strong healthy boy with no stricture of his esophagus and has had no difficulty whatever in swallowing. Dr. Taylor showed the corresponding clip to that which had been swallowed and called attention to its nickel-plated condition, stating that the nickel-plating of the clip which had been swallowed had been absorbed while the clip was in the child's throat.

Dr. Taylor desired to repeat his statement that he thought it always safest, after a foreign body had been for some time imbedded in the esophagus, to do an immediate esophagotomy rather than try to remove the object with a coin catcher or forceps.

DR. JOHN H. GIBBON considered Dr. Taylor's attitude rather radical. He referred to a case in which he had removed an ordinary campaign button which had been in the esophagus for

eleven days. This patient made a good recovery. He thought one had to be guided entirely by the character of the body in the esophagus and by the symptoms. Esophagotomy carries with it a certain amount of danger especially from pneumonia, and a case in which an esophagotomy is done in the presence of ulcers is always in danger of a pneumonia. He considered it wise to make an endeavor to remove the foreign body unless the evidence goes to show that such an attempt would be dangerous. He did not believe any rule could be laid down as to the performance of an esophagotomy after the foreign body had remained any certain time in the esophagus, especially when the foreign body was smooth or round.

Dr. John B. Roberts mentioned the case of an infant who had swallowed a jackstone. The patient was referred to him last spring, a day or two after the accident. It had been seen by other physicians in the meantime. Dr. Roberts tried unsuccessfully to get the jackstone out by the mouth. Finally an esophagotomy was done, and unfortunately, on account of not being able to get a guide into the esophagus he made a slight puncture in the trachea. He removed a six-ended jackstone from the child's esophagus. The patient did fairly well for a few days but the wound finally became very septic and she died of a capillary bronchitis. Dr. Roberts thought that if he had seen the patient earlier and had resisted the temptation to attempt removal through the mouth, and done esophagotomy earlier he might have had a better result.

Last winter, with an ordinary coin catcher he succeeded in removing a coin from the esophagus, after it had been swallowed but a few hours.

Dr. A. C. Wood agreed with Dr. Gibbon that some judgment should be exercised in adapting the method of removal to the kind of body, as well as to the time that had elapsed since it was swallowed. An irregular object, such as a jackstone, would cause ulceration more rapidly than one that was smooth and round such as a coin. There is good reason to believe that it would have been dangerous to attempt to fish out the clip shown by Dr. Taylor.

He referred to his experience in five cases in which jackstones had been swallowed. In two of these the jackstone was removed by means of a gastrotomy, after efforts at removing

it through the mouth failed. The stones were brought into the stomach and removed without serious consequences, the children making normal recoveries. He had tried various esophageal forceps without success in three cases in which he was able barely to touch the jackstone with the tip of the index finger. By using this finger as a guide and employing a hook like a tenaculum, bent to the proper curve, he was able in these three cases to get the body up without difficulty and without danger to the child. He considers esophagotomy such a serious operation in itself that it should be resorted to only when all other appropriate means have failed.

Dr. John H. Jopson recalled several cases in this connection. In one case he was able to extract a jackstone by passing an English catheter alongside of it and withdrawing catheter and jackstone together. He has never had much success with the esophageal forceps in children. He referred to an unfortunate case at the Children's Hospital this Spring where a nickel had been imbedded in the esophagus for several days. The X-rays located it in the neighborhood of the cricoid cartilage and an attempt at extraction was made with some new instruments. The coin catcher was too large and almost became impacted. Jopson feared it would be necessary to do an esophagotomy, but on the following day his assistant brought a coin catcher from the University Hospital and with this the coin was brought out with the first effort. Dr. Jopson therefore considers the shapes and sizes of coin catchers important. This child was taken home that night against his advice, and had an attack from which it died in a few hours. The cause of death was not determined, but there may have occurred a pressure perforation of the esophagus or an edema of the glottis.

Dr. John H. Gibbon also referred to a case which was under his care at the Pennsylvania Hospital last winter. The patient was a child four or five years of age who had swallowed a jackstone. Numerous attempts had been made at removal of the stone before her admission to the hospital. Dr. Gibbon thought he could feel the stone with the forceps but was unable to remove it. The child was anesthetized and the stone seen distinctly through the fluoroscope. This case illustrates well the advantage of the fluoroscope. This stone and forceps could be distinctly watched throughout the removal: the forceps grasped

first the smooth end of the jackstone and slipped off, the stone was then turned round and the knobbed end of the jackstone caught. This was one of the most satisfactory uses of the X-ray in the removal of foreign bodies that Dr. Gibbon has ever experienced. This child developed a pneumonia from which she died two or three days after the removal of the stone.

DR. CHARLES L. LEONARD (by invitation) referred to a case sent to him from North Carolina for examination by the X-ray. The patient had been X-rayed but no foreign body found. He discovered a coin in the esophagus, which was finally removed with the coin catcher some 18 months after it had been swallowed. This was in a boy of twelve years. Dr. Leonard also stated that it was not now necessary to make an X-ray examination under ether, because these examinations could now be made with exposures of ten seconds, or less.

DR. CHARLES F. NASSAU, in closing, said there is no question whatever that when given a foreign body, either smooth or a jackstone, attempts may be made to extract the body. With this baby he made reasonable efforts after touching the object with the esophageal forceps, which he had no difficulty in introducing. He thinks a difference should be made between bodies which have been for a comparatively short time and those which have been in for months, for where an object has been in only a short time infection there is severe; if it had been there for a long time Nature will have done, as she does everywhere, build a wall round that body which will protect the tissues outside from the extension of infection due to reasonable manipulation. He does not believe from his small experience that esophagotomy is such a serious operation as one would suppose. In the case of this child he cut no vessels, while in that of the heavily built man with the plate of teeth in his esophagus, Dr. Nassau tied the inferior thyroid and one small branch running anteriorly from the vessel and put only two ligatures in the wound. When he opened this esophagus there was a gush of purulent material, and of course with this condition present it would have been death to his patient to have attempted to remove the object by any other means. In neither of his cases could the object be felt by a finger in the throat, they were both lodged in the esophagus. They could, however, be touched with the forceps. As to the use of a guide Dr. Nassau said that after feeling the foreign

body he took out the forceps, made the incision as far as the esophagus, and then reintroduced the forceps in the case of the man, but not in the baby. The prongs and edges of the plate of teeth had imbedded themselves and sepsis was beginning at a serious rate, and he found the forceps a great aid in this condition. The patient's temperature went up that night to 104°, but on the fourth day was normal.

SIGMOID DIVERTICULITIS (MESOSIGMOIDITIS) IN A CHILD.

Dr. Astley Paston Cooper Ashhurst presented a boy aged seven years and nine months, whom he had seen on the evening of July 18, 1906. In the absence of Dr. Hutchinson, to whom he was indebted for the privilege of operating and of reporting the operation, he was called to the Children's Hospital to see the patient, who had just been admitted with the diagnosis of appendicitis. The patient's family history was negative; he had had measles and mumps, but not recently. For the past two weeks he had had pains in the abdomen, chiefly around the umbilicus, and not very severe until three days before admission. Then he lay on the bed, doubled up as if with cramps, but did not vomit until the day he was first seen by Dr. Ashhurst. His mother said that his bowels had been opened several times daily. The pain was said to be paroxysmal, becoming very severe at times. On admission, at 9 P.M., the temperature was 101.4° F., pulse 128, respirations 32 per minute. The abdomen was held very rigid throughout, but it seemed to be a voluntary rigidity, and there did not appear to be diffuse peritonitis. There was retention of urine, the dulness due to the distended bladder being evident on percussion in the hypogastric region. The urine was drawn twice by catheter, but subsequently was voided spontaneously.

The presence of appendicitis was excluded after the first examination, but no satisfactory diagnosis was made. Rectal examination was negative. It was decided to await the development of more certain symptoms before undertaking an exploratory operation. The bowels were opened only by enema. No purges were given at this time.

Not until the third day after admission was palpation of the abdomen entirely satisfactory. It was now possible to feel a mass in the left iliac fossa. This mass was firm and tender on

palpation, and seemed attached to the iliac bone in the neighborhood of the left sacro-iliac synchondrosis. The mass extended nearly half way from Poupart's ligament to the umbilicus. It was dull on deep percussion, and did not seem to be in close contact with the anterior abdominal wall. The rest of the abdomen was flaccid, and there was no tenderness except on firm pressure over the tumor. The tumor could not be reached by the finger in the rectum, and rectal examination was in no way painful. No polyp was detected. The question of diagnosis was still undetermined, but lay between sarcoma of the sigmoid and an inflammatory mass, which latter, it was thought, might have been caused by a previous attack of appendicitis. Psoas abscess was excluded on account of the absence of all bone lesions, and because of the presence of early symptoms of intraperitoneal irritation. Iliac abscess, of traumatic or tuberculous origin, was also excluded for the latter reason.

The child was seen by various members of the staff, both surgical and medical, but no positive diagnosis was suggested. Purges and enemata were administered until the possibility of fæcal impaction was absolutely excluded. The leucocyte count was 6,400 the day after admission. One week later 7,200.

Exploratory laparotomy was done on July 27, nine days after admission. An incision, nearly three inches in length, was made in the left rectus muscle above Poupart's ligament. There was much bleeding from the abdominal wall, and the transversalis fascia and peritoneum were much thickened. On opening the peritoneum there escaped several drachms of clear serous fluid, with no odor. Its appearance suggested the possibility of a rupture of the bladder, with the extravasated urine encapsulated by adhesions. There were light inflammatory adhesions between the outer layer of the mesosigmoid, and the parietal peritoneum. A gauze pack was introduced to exclude the small intestines from the field of operation, and in doing this there was detected in the mesosigmoid a dense mass, nodular, stony, hard in places. The sigmoid with its attached mesentery was then partially delivered through the wound, the mesosigmoid turning on its attachment to the posterior abdominal wall like a door on its hinges. The tumor in the mesosigmoid was the size of a goose egg, and several enlarged lymph nodes were seen on its surface, just beneath the serous covering. The sigmoid itself was in no way

obstructed, but passed over the surface of the growth, and was normal to all appearances. No tubercles could be seen on the tumor, the sigmoid, the parietal peritoneum, or elsewhere in the field of operation. The tumor was of such cartilaginous hardness in places that it seemed impossible for it to be merely inflammatory in nature. It was thought to be a retroperitoneal sarcoma, and as its removal would have required resection of the sigmoid from the level of the iliac crest down into the true pelvis, all thought of radical operation was abandoned. One enlarged gland, close to the mesenteric border of the sigmoid, was removed from the surface of the tumor beneath the external layer of the mesosigmoid; the incision in the mesosigmoid was sutured; and the abdominal wound was closed in layers. The time of the operation was forty minutes. The convalescence was uneventful. The wound was dressed at the end of a week, the last sutures were removed three days later, and on the twelfth day the patient was allowed out of bed. He was discharged August 11, 1906. An examination of the blood, made August 1st, five days after the operation, showed that the leucocytes numbered 13,200, and that the hæmoglobin was 55 per cent. On the same day Dr. C. Y. White reported that microscopical examination of the gland removed at operation showed marked inflammatory exudate throughout its structure. No evidence of tuberculosis could be detected.

The patient was seen again in the Dispensary three weeks after operation. The wound was firmly healed, but the tumor seemed to be nearer the median line of the abdomen, and was not apparently attached to the left iliac bone as before the operation. His bowels had been opened normally, without enema or purge, twice daily since leaving the hospital. The patient's mother was informed that an inoperable tumor had been found, and a gloomy prognosis was given.

On November 17, 1906, about three months and a half after the operation, Dr. Ashhurst examined the patient at his home. He was playing around the streets, and had been in excellent health. His bowels opened normally, his appetite was good, and he never had any pain. Careful abdominal examination failed to reveal any evidences of the tumor. He had seen the child at intervals since then, and presented him to the Academy in perfect health, and without the slightest evidence of tumor.

Dr. Ashhurst said that until within the past year, very little surgical attention had been devoted to inflammatory lesions of the sigmoid and its mesocolon. During that time a large number of contributions have appeared, and the pathology and nomenclature of these affections are becoming better understood. The literature of acquired intestinal diverticula, up to 1904, has been admirably summarized by Dr. Edwin Beer of New York, and within the past year the diagnosis and treatment of inflammatory affections of the sigmoid have been discussed by Brewer, Lejars, Mayo, Monsarrat, Patel, Ries, Rosenheim, Sieur, and others. The lesions reported by these authors may be classified as follows:

1. Sigmoiditis—inflammatory hyperplasia of the walls of the sigmoid converting it into a rigid tube, and usually causing a certain amount of obstruction.

2. Perisigmoiditis—suppuration, usually localized, due in most cases to perforation of a sigmoid diverticulum. Appendicitis is still recognized as a possible cause of perisigmoiditis.[1]

3. Mesosigmoiditis—which, in the patients reported by Ries, was characterized by the presence of cicatricial bands in the mesosigmoid, leading in one case to volvulus, these bands being the result of previous more or less acute inflammatory changes.

Most of the cases reported have belonged to one of the former classes, a majority probably being characterized by perisigmoid suppuration. It seems probable that in this case, described by the term mesosigmoiditis, the original lesion was a diverticulitis within the layers of the mesosigmoid. It is well known that diverticula occur in this situation, as well as on the free border of the sigmoid; and though their presence in any but adults is denied by many writers, other authorities acknowledge the existence of congenital diverticula. In none of the reported cases, however, so far as he had been able to ascertain, was the patient below the age of puberty;[2] and in none has there been such a marked tumor of the mesosigmoid, with so little perisigmoiditis. Dr. Deaver, however, had informed him that he had operated on a patient (an adult) in whom the patho-

[1] Perhaps the term pseudo-sigmoiditis might be employed to describe inflammatory lesion in the neighborhood of the sigmoid, caused by primary disease of the appendix, ovary, or Fallopian tube.

[2] Patel, in a paper published since the above was written, refers to a case in a girl of 10 years, reported by Walcha.

logical lesions considerably resembled those in the patient now reported; except that in Dr. Deaver's patient the mass in the mesosigmoid was much softer, the sigmoid itself was quite strictured, and when the bowel was opened an ulcerated spot (not a diverticulum) was found at its mesenteric attachment.

The treatment to be adopted depends very much on whether the condition is recognized as a purely inflammatory one, or whether, as in most of the earlier cases, it is considered malignant. In the latter case resection will be adopted for the operable cases; and the inoperable cases will be treated by either colostomy, enteroanastomosis, or exclusion if there is obstruction, or the abdomen will be closed, as in the present case, when no obstruction exists. If the presence of pus, or the history of early inflammatory symptoms, on which as a diagnostic point Lejars lays so much stress, make it seem probable that the condition is inflammatory, it will probably be best merely to drain the purulent focus and release such adhesions as obstruct the lumen of the sigmoid.

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Dr. A. C. Wood considers the pathology of these inflammatory lesions about the sigmoid more complex than might be supposed at first thought. They are not all secondary to diverticula; probably but a small minority are due to this cause. He has read of cases that were due to perforation of the sigmoid by foreign bodies; in one instance a pin had passed through the wall of the bowel, causing an abscess, and in another fragments of straw had in like manner perforated the bowel. Cases are reported in which the epiploic appendages were involved in these inflammatory swellings. Although the case reported by Dr. Ashhurst is the youngest he has heard of, he believes it is generally admitted

that these diverticula may be either congenital or acquired, and if congenital, there is no reason why they may not cause trouble in early life. He does not consider the explanation that the diverticula result from constipation and distention of the bowel with protrusion of pouches of mucous membrane through the muscle fibres a satisfactory one.

DR. ASTLEY P. C. ASHHURST, in closing, said that in his case the diagnosis was of course largely conjectural; he thought, however, that the mass certainly was one of enlarged glands, but he believes that if these glands had been simply tuberculous in character, which he considers a rarer condition in the mesosigmoid than the presence of diverticulum, there would have been symptoms of tuberculous disease and the course of the case would not have been so favorable. Although the condition is a rare one he sees no reason why this should not be considered a case of diverticulitis.

RADICAL CURE OF UMBILICAL HERNIA IN A CHILD WITH PRESERVATION OF THE NAVEL.

DR. ASHHURST reported the case of Thomas S., aged two and a half years, who had suffered since infancy with an umbilical hernia, which on admission was the size of an English walnut, and was easily reducible. The ring admitted the little finger. There was also a right inguinal hernia.

Having seen the suggestion that the navel be preserved in operating on children, especially boys, for the radical cure of umbilical hernia, he determined, at the risk of being thought to do a complicated operation where a simple would suffice, to attempt such an operation in this case. For the privilege of operating and of reporting the operation, he was indebted to Dr. Hodge, in whose service at the Children's Hospital the patient was treated.

The operation was done July 25, 1907. A crescentic incision was made below and surrounding the navel, down to the sheaths of the recti muscles. The flap of skin and subcutaneous fat thus outlined was dissected upwards, for an inch or more above the navel, the hernial sac being opened just beneath the umbilicus. The flap containing the navel was then turned upwards, and the sheath of the rectus muscle on each side was opened transversely at the level of the ring. The sheaths with the intervening

linea alba were then dissected free from the underlying transversalis fascia and peritoneum. Then with three mattress sutures of chromic catgut the aponeurosis below the ring was drawn upwards into the slit between the transversalis fascia beneath and the sheath of the recti muscles superficially. The flap of aponeurosis on the thoracic side of the hernial ring was then sutured (with continuous stitches of chromic gut) to the sheaths of the recti muscles below, thus interposing, as in the usual overlapping operation, two layers of aponeurosis between the peritoneal cavity and the subcutaneous tissues. The skin flap was then sutured back in place, and a small catgut drain was introduced beneath it at one angle of the incision, because the absence of the hernia and the overlapping of the aponeurosis had made the skin flap somewhat redundant, and it was feared that some serum might collect beneath it were no drain employed. This drain was absorbed, having fulfilled its purpose, before the first dressing of the wound, when union was found firm throughout. The operation took only twenty minutes to do, and as the scar fades away in the natural creases of the abdomen it will be barely possible to tell that any operation has been done (Fig. 1). The boy at least will not be an object of ridicule among his companions in bathing, etc.

The inguinal hernia was operated on at the same sitting. It was a hernia into a patulous processus vaginalis testis, and the Bassini operation was done. Both scars are now perfectly firm, and the boy is in excellent health.

Dr. John H. Jopson said that in 1906 he had seen Dr. James Stone of Boston operate for umbilical hernia in a child at the Boston Children's Hospital, and Dr. Stone advanced the same reasons for preserving the umbilicus that Dr. Ashhrust had mentioned. He did not do as Dr. Ashhurst described, but made a linear vertical incision. Dr Jopson repeated this operation on a child at the Presbyterian Hospital last winter. Referring to Dr. Ashhurst's first case it seemed to Dr. Jopson that the diagnosis of diverticulum was only a matter of conjecture, and that in the absence of an opportunity for resection and examination of the tumor and as there were undoubtedly enlarged glands in the mesentery it might just as well have been considered a case of enlarged glands in the mesosigmoid as the rare condition of diverticulitis.

FIG. 1.

Result of operation for umbilical hernia with preservation of the navel.

LUDWIG'S ANGINA.

DR. T. TURNER THOMAS read a paper with the above title, for which see page 161.

DR. G. G. DAVIS said that this was an intricate subject and one with many points needing elucidation. The pathology is intimately associated with the treatment. The disease is quite a fatal one, the mortality is still quite large. There seems to be no absolute accepted line of treatment: Dr. Thomas' paper points out a line of treatment. If the disease kills by interfering with the breathing, then the line of treatment should be to obviate as much as possible the edema of the glottis and the encroachment upon the air passages. If, however, infection is the lethal agent, then the treatment should be directed to that cause. Dr. Thomas spoke of 92 out of 106 cases beginning external to the mouth and this brings up the cause of the infection beginning external to the mouth, probably in the submaxillary or retromaxillary region. It is very hard to see what should cause a primary infection of that region. Dr. Davis personally believes that the infection begins most often in the mouth and travels to the other tissues. He called attention to the statement made by Dr. Thomas that one author stated that the infection travelled to the lymphatic glands in the submaxillary region, being conveyed by the lymphatics from the primary focus in the mouth. Dr. Davis does not believe it is a question of the lymphatic nodes. Inflammation of the submaxillary lymphatic nodes and of the retromaxillary lymphatics along the large vessels can as a rule be outlined by the sense of touch. The involvement of lymphatic nodes is usually more or less limited. This disease to Dr. Davis' mind pursues an entirely different course. Instead of producing discrete lymphatic enlargement we practically never see discrete inflammatory enlargement of the lymphatics. There is a widespread, board like, inflammation in which all evidence of lymphatic nodes is obscured and there is no outline of any nodes. He believes the disease propagates itself by direct continuity of the cellular tissue.

It is hard to point out an absolute cause in all cases. In several cases which Dr. Davis has seen he believes the cause of the infection to have been in the teeth. He called attention to the specimen presented by Dr. Thomas showing the connection

between the mouth and the throat. It is obvious that if a person has an ulceration of the root of the teeth, and particularly if there is pus around a decayed tooth, it involves the submaxillary gland because this gland lies quite close to it, and if it simply follows the submaxillary gland down it goes right out of the mouth into the neck. It is extremely difficult to state definitely that the trouble originated submaxillarily and not intra-buccal.

As regards the character of the inflammation Dr. Davis believes it is generally admitted from a bacteriologic standpoint that several kinds of bacteria give rise to this disease; in other words, not only has the streptococcus been found in a large number of cases, but in several of the cases the disease has been found to contain, so to speak, only microorganisms which are of a single type, not streptococcal: for instance, pure pneumococcus cultures, and the staphylococcus, besides other bacteria have been found.

There is a question as to what extent is there sepsis and to what extent is there suffocation as relative lethal agents in this disease. There have been cases in which there was absolutely no indication of the slightest obstruction with respiration in which death ensued, which could only have been caused by infection.

Dr. Davis does not accept the temperature as a guide for septic infection. He stated that in some of the worst cases of diphtheria the temperature is low, while in other parts of the body, the appendix for instance, the infection can be very marked and the temperature can be low. One of the first things that strikes the physician in many of these cases of Ludwig's Angina is the depression of the patient. Some patients have the great swelling with no depression whatever, while others have a terrible amount of depression. Sometimes the pus is both free and offensive. Dr. Davis has seen two or three cases where the swelling has broken alongside the alveolus close to the bone. With regard to the making of incisions his favorite one is directly in the median line, as through this incision the finger can be put right through into the mouth, and the serum also drains freely into it.

He believes the disease is a local one, and that it often kills by infection, although a certain proportion of the cases are accompanied by respiratory symptoms. In these cases the larynx

is gradually choked off, and then the patient goes around until something causes complete obstruction, when naturally he dies. There are other cases which pass through a typical pyemic condition with chills, fevers, sweats, temperature 104° to 105°, who die absolutely of sepsis without any respiratory difficulty whatever.

Dr Davis believes the line of treatment to be pursued is that which would direct against any local septic trouble; he considers free incisions perfectly justifiable in bad cases, in fact one reaching almost from below the ear posteriorly to near the symphysis anteriorly.

Dr. W. Joseph Hearn called attention to the difficulty of etherizing patients suffering from Ludwig's Angina. In three cases which he had the opportunity of seeing there was great difficulty in this direction. In every case the patient was nearly suffocated. He was present at one operation where the surgeon had hardly got the patient half under ether when he was obliged to do a tracheotomy to keep the patient from suffocation. In one case of his own he attempted to give ether, and the man became cyanosed. Dr. Hearn therefore discarded the anesthetic and made free incisions as in ordinary cellulitis: this patient recovered. Dr. Hearn presumes from the difficulty in administering ether that the pharynx and larynx must be involved.

Dr. Charles F. Nassau stated that his experience with this condition was limited to two cases, although he also had the opportunity of observing a third that was under Dr. DaCosta's care at the St. Joseph's Hospital: this patient died.

It is Dr. Nassau's belief that the patients who get well are those in whom suppuration has been established. In one of his cases the condition followed during convalescence from scarlet fever; cover slips were made and there was found to be a streptococcus infection. In both his cases the operation was done on account of the extremely rapid spread of the infection outwards and over the chest; in both the infections probably occurred through the tonsil as both patients complained of a tonsillitis a few days previous. In one of his cases this tonsillitis cleared up to some extent and then this infection began, slightly at first, occupying at least three or four days in its development; the patient did not have much fever nor pain, but when seen by Dr. Nassau she was in a good deal of pain; she took ether very well.

The other patient, not only on account of her extremely ill condition but particularly on account of the place where she was, was operated upon under cocaine anesthesia. This merely saved her the pain of the skin incision. In neither of his cases did he find any pus; the nearest approach to it was in the second case, where behind the sheath of the common carotid a few flakes of lymph were found, possibly the beginnings of suppuration.

Dr. Nassau believes in the very widest and largest possible opening, even by the tearing up of tissues if this is found necessary. He believes that where the infection simply travels without suppuration the patient has a splendid opportunity of being carried off by the infection. He argues that sometimes one organism or one infection can be replaced by another; for instance, in an infection of the Fallopian tube which was probably of gonorrhœal origin, there may be an acute flare-up, and at operation no gonorrheic organism found, it having been replaced by the streptococcus or some other organism of suppuration. In the same way there may be a peritonitis from, say, the colon bacillus, and at autopsy one may find only streptococcus as the fatal cause. Therefore one organism will kill another. This is the basis of what treatment Dr. Nassau has given other than incision. His idea was to bring about suppuration as quickly as possible and to get the wound infected with something else. He does not consider it good treatment to keep these wounds too clean, but that a chance should be given for suppuration.

Dr. W. M. L. Coplin (by invitation) stated that he considered this subject of special interest to pathologists. For twelve years he has been directly interested in it. To call the condition cellulitis may be the truth but it is not the whole truth; it is really a myositis. It is peculiar in its distribution along the course of the muscles, and the change that takes place in the muscle fibres. If one will carefully examine these muscle fibres one will find that within the perimysium there is an extending exudate with the usual progressive myolysis occurring in various types of muscle inflammation, and an accumulation of numerous leucocytes within the muscle. He thinks one of the conspicuous features in cases of Ludwig's angina is the immunity of the lymph system. He has one specimen, a complete evisceration of the cervical region, in which the lymph nodes were examined microscopically, and showed practically no infiltration, one knows

of course that where an inflammatory condition involves the primitive lymphatics there is almost invariably a leucocytic invasion of the lymph nodes. In two of the cases in which Dr. Coplin made complete sections of the neck he secured the glands and was amazed by the escape of the glands from this process. With regard to the submaxillary and the sublingual salivary glands, he has a specimen from a case which has been reported, in which these glands are bare and section shows that they practically escaped infiltration. The condition in one case in which it was impossible to make a complete dissection of the neck certainly began as a paramygdalitis. Sir Felix Semon refers to one or two cases beginning with what we would now call paramygdalitis. In this case the tonsil was almost completely dissected out by the extending necrosis but on section the organ is but slightly involved, again illustrating the fact that the lymphatics may escape. With regard to the type of infection it is Dr. Coplin's opinion that it is etiologically a polymicrobic process. It is not a disease that should be given a distinct pathological position; because of its symptomatology, largely determined by the peculiar anatomy of the neck, it might be regarded as a clinical entity.

To return to the phenomenon observed in the muscle. The myochrome disappears early, giving the muscles a washed meat appearance. Dr. Coplin has seen muscles of the body of the tongue almost the color of the white meat of chicken. The muscle change resembles, possibly superficially, that peculiar disease known as the infectious myositis of Japan. The washed meat appearance is a very striking manifestation of infection travelling widespread through the muscle without focal necrosis. If one recalls the capillary injections of muscles in which a muscle fibre is seen festooned by the most elaborate capillary circulation, like vines around a column, one can understand that an infection gaining sufficient headway to sweep like fire through that kind of a circulatory field, yields its toxin directly to the circulating blood, hence must cause great depression; even with a limited area of infection the systemic phenomena would be largely dependent upon the toxicogenesis of the invading organism.

Dr. Coplin would look at the suggestion made by Dr. Nassau that where suppuration occurs the patients would be better, from just the other side. It seems to him that the explanation of these

cases is that the attack made by the antibodies is such as to secure a focusing of the infection and establish a necrosis in that area of limitation; that where the individual is unable to resist the infection it travels with such rapidity that we do not see a marked accumulation of leucocytes. That in these cases where suppuration does not occur there is just as much disintegration and destruction of the myochrome as in cases where suppuration does occur, but there is an immeasurably less abundance of leucocytes, and a less accumulation of antibodies.

Dr. Coplin was greatly interested in the effect of the disease upon the organs of respiration. In one case which he had the opportunity to examine in very great detail, there was a clearly defined streptococcal bronchitis, while between the intralobular spaces one could see the lines of an interstitial pulmonary lymphangitis. Delicate yellowish lines traced over the incised surface of the organ and extended toward the pulmonary lymph nodes, and in this very case there was, in the peribronchial lymph nodes, no cellular infiltration.

In some of these cases there is a respiratory difficulty behind the respiratory obstruction of the larynx, just as we occasionally see in puerperal sepsis, in erysipelas, and in that peculiar disease, Brinton's disease, the absorption of toxic material and the induction of advanced suppurative interstitial pneumonia. Dr. Coplin believes this is in some cases mistaken for capillary bronchitis, which presents a very similar clinical picture.

With regard to the atrium of the infecting organism Dr. Coplin does not consider this of much importance, and believes that it has little material influence on the pathology of the lesion.

"COINCIDENT ABDOMINAL LESIONS."

Cases: (I) *Appendicitis with ruptured extra-uterine pregnancy.* (II) *Appendicitis, pregnancy and ureteral calculus.* (III) *Dermoid cyst of ovary, pregnancy and gallstones.* (IV) *Tuberculosis of ovary and appendix with floating kidney.*

Dr. Geo. Erety Shoemaker said that the subject of combined operations or of operations for different lesions present at the same time, was one of interest and importance, frequently calling for the exercise of judgment. A number of years ago he read a paper before the Academy of Surgery advocating the removal of the appendix, if not normal, in all suitable cases when

the abdomen was opened for other purposes. The proposition was received with little respect at that time, but in the evolution of surgical opinion has since become the practice of many good abdominal operators. When operating for other abdominal conditions, examination of the appendix, in all patients not in immediate danger from shock or exhaustion, and where the fear of spreading septic material from another focus does not deter, will result in demonstrating in at least 25 per cent. of cases evidences of sub-acute or chronic disorder of the appendix. In his last 400 abdominal operations not undertaken for appendicitis alone, the appendix was removed in 88, or 22 per cent. Some of these disorders involve the organ only from without and can do harm chiefly by interference with drainage, through angulation from contraction of the meso-appendix or of surrounding adhesions. Other cases show evidences of intrinsic disease of the appendix in various stages of development. This is particularly true of chronic pelvic inflammation with definite lesions of other viscera, especially tubercular.

It may be difficult before operation to separate the appendiceal from the other inflammatory conditions present. Interesting papers have been presented on the topic of referred pain leading to obscurity in diagnosis between appendicitis and kidney or gall bladder disease chiefly. His object here was to draw renewed attention to the fact that even when one definite and important lesion is demonstrated and removed at operation the surgeon should not stop, particularly in chronic cases, until he determines that other organs are not involved. Dr. Mayo has recently spoken of the systematic examination of the gall bladder from the lower incision. This of course can only be done when the incision is large enough to admit the hand and wrist, and should be omitted when dealing with pelvic infections. It does not by any means follow that the second lesion should be operated upon at the same sitting. Indeed, it might be a serious error, to attempt to deal with a badly adherent and inflamed gall bladder, the same day that an acute appendicitis required operation, or vice versa. A bad hysterectomy may tax the patient's resources, and the removal of an adherent appendix might bring the colon bacillus risk into an otherwise clean field. Quiescent inflammatory conditions of moderate severity in strong patients may, however, be attacked at the same sitting, especially if in the

same general locality. A movable kidney which is bad enough to cause trouble may be anchored at the same time that a chronic appendicitis is cured by appendectomy.

In gynecological work it is constantly found that the same patient presents several conditions each of which causes trouble. Hemorrhage requiring the curette; laceration of cervix and perineum requiring repair; bleeding and prolapsed hemorrhoids requiring operation; chronic salpingitis and appendicitis requiring conservative operation. These may all be dealt with at the same sitting only if the inflammatory processes are quiescent. If they are active the operations must be done in two groups, and the more serious should be done first. He had a patient now convalescing in whom all of these conditions were operated upon at the same time.

The patient must not be kept too long under ether and after the abdomen is opened, no work on another part should be done. Minor procedures, such as repair of lacerations, should be carried out first, as these cause no definite strain, and the patient's danger begins only when the abdomen is opened. Of course gloves and instruments are changed when the field is changed to the abdomen. He reported the following instances of combined lesions of important type:

I. *Extra-uterine pregnancy associated with appendicitis.* C., 41 years. Not previously pregnant for 14 years. Menses irregular and apt to be profuse for nine months. No periods missed, but the last one, which began six weeks before examination, had been a week late, and bleeding had continued ever since. The rupture of the left pregnant tube had occurred two weeks before with sharp pain followed by fainting and perspiration. The ovum was still in the tube in a tiny unruptured sac of fluid. Pregnancy was probably not over six weeks old. There had been much rectal bleeding for several months, temperature had never been found by her physician to be over 100 when taken. Symptoms had been so mixed including bleeding from bowel and vagina, severe pain in left abdomen chiefly and abdominal soreness and chronic indigestion, that attention had never been definitely fixed by her physician upon the appendix region and an attack of moderate severity had doubtless passed over before the ruptured extra-uterine pregnancy occurred.

When referred to him in his office, the diagnosis of ruptured

extra-uterine pregnancy was made and operation advised and performed the same day. The left tube was ruptured near the attachment of the broad ligament, many ounces of free blood and clot found in the peritoneal cavity. Tube removed leaving corresponding ovary. Examination of the appendix showed a hard meso half an inch thick, the appendix walls dusky red, hard, thick and rigid, the mucous coat purple, no pus; removal. Diagnosis: Decided sub-acute appendicitis without perforation. Ruptured left pregnant fallopian tube and intra-abdominal hemorrhage. It is interesting to note that in the four months which have elapsed since the operation the troublesome chronic indigestion present for years has disappeared.

II. *Coincident acute appendicitis: pregnancy and ureteral calculus with nephritis.* E. G. A patient is now in the Presbyterian Hospital where three prominent conditions had to be considered. *First,* pregnancy at four and a half months, with a very high right uterine cornu. *Second,* severe pain with tenderness behind and about right kidney, much blood in the urine, abundant dark granular and other casts, the pain passing down the course of the right ureter to right vulva. *Third,* an acute right sided abdominal inflammation with temperature to 103°, chills and a septic look. Leucocytosis 25,000.

This case was cleared up: first by the passing on the day of admission of a sharp pointed crystal with the urine with relief of kidney pain; second, by laparotomy and removal of appendix, the abdomen containing about two ounces of free turbid fluid, no adhesions, peritoneum deeply congested in right abdomen; third, by the use of large quantities of water by mouth and salt solution by rectum to overcome the nephritis. The pregnancy was undisturbed, the child lives. The gauze drainage has now been removed and the wound is healed. The general condition good except for nephritis.

III. *Coincident dermoid cyst of ovary, pregnancy and gallstones.* J. C., 35 years old, 6 children. Applies (*a*) because of severe pain in gall bladder region for one month, through to shoulder. Constant distress also in epigastrium. No vomiting, no jaundice, no putty colored stools. Only similar attack followed a confinement two years before. Examination shows (*a*) a tender, small gall bladder. (*b*) A rounded tumor four inches long, adherent in pelvis with much soreness and pain about it.

(*c*) Pregnant two months. Perineum and cervix much lacerated.

As an adherent tumor overlying a pregnant uterus was a greater present menace than the sub-acutely inflamed gall bladder, the abdominal incision was made low down and a dermoid cyst of the left ovary four inches by three by two and a half firmly adherent was removed without rupture. It contained bone an inch long and cholesterin. The appendix was quiescent but showed old inflammatory changes. It was removed through the same incision. The gall bladder was examined through the lower incision and found to be tightly contracted around two large gall stones into an hour glass shape. There was no fluid. Operation on the gall bladder was postponed until after delivery, in the absence of dangerous symptoms. Recovery followed from the dermoid operation and appendectomy, the woman was delivered at term seven months later. She was seen a few days ago, and as she still complains of the gall bladder soreness she is to have an operation as soon as her child is old enough to wean.

IV. *Tuberculosis of ovary and appendix. Movable kidney.* M. E. Single, 27 years. Attack called appendicitis four years before and a second two months before; ever since which walking and jarring hurt the right lower quadrant and up behind the kidney. Loss of weight 13 pounds, now 105. For two months an inflammatory swelling on 7th rib in front. Pain in right upper abdomen at times severe and apparently due to a very movable kidney which varies in size, now presenting a fusiform swelling which is movable and can be displaced upward as far as the umbilicus. The appendix is tender, the tubes and ovaries are fixed. The patient was bright, cheerful and intelligent; keenly desired relief. Urine normal.

To overcome the pain crises in the right kidney region, as the fusiform swelling was probably an early hydronephrosis, the kidney was anchored. The appendix was exposed through a gridiron incision. The peritoneum nearby was sparsely studded with small tubercles; no fluid, no adhesions. In the meso appendix a cheesy nodule size of grain of corn. Appendix sub-acute catarrhal inflammation, removed with cheesy meso: stump buried. Through the gridiron incision the tubes were felt to be diseased. It was therefore closed and a small median incision made, through which by catgut ligation, the right tube was

resected and the left removed at the cornu. One-third of the left ovary was removed. The tubes formed closed sacs imbedded in adhesions. No drainage.

Convalescence extremely smooth. Wounds healed primarily. Several days later under local anesthesia a fusiform yellowish floculent mass of material looking like coagulated lymph was removed from the periosteum of the 7th rib, leaving a smooth glistening cavity which promptly healed with packing. Pathological report of Dr. Steele: Tuberculosis of ovary, giant cells and typical areas of infiltration. Cells of larger type found in tubercles. No giant cells or caseation found in tubes.

These operations were done two years ago. Patient seen recently. Scars sound. No abdominal symptoms. Menstruation regular and painless. Walks well and works without distress. Kidney in place, no trouble since. No disease or tenderness in tubal or ovarian regions discoverable on examination of pelvis. Lungs negative. Weight same as before operation, 105. Considers that operations were of enormous benefit to her and claims to be gaining in general health, though still slender and rather pale.

BOOK REVIEWS

DIE VERWUNDUNGEN DURCH DIE MODERNEN KRIEGSFEUERWAFFEN, IHRE PROGNOSE UND THERAPIE IN FELDE. By DR. GRAF of Dusseldorf and DR. HILDEBRANDT of Berlin. Volume II, 8¼ x 5½, pp. 579; 180 illustrations. Berlin, August Hirschwald, 1907.

The second volume devoted to "Wounds Caused by Modern Firearms" by Drs. Graf and Hildebrandt, has just appeared and is a valuable addition to medical knowledge, especially to military surgeons, since it is devoted primarily to diagnosis and treatment in the field.

Instead of the general discussion of the subject found in the first volume of the work, this portion is devoted to the special consideration of wounds involving different portions of the body.

The statistical research involved in the preparation of this volume must have been enormous, since the results of all the important wars between civilized nations since the Crimean War have been collected and utilized. The Franco-Prussian War, the American Civil War, the Boer War in South Africa and last of all the valuable statistics relative to the Japanese-Russian War have all been drawn upon. In this connection it is interesting to note that the percentages obtained in these various points relative to the parts of the body involved have not varied materially in a half century, and while there is a slight improvement in the mortality attending the treatment of wounded soldiers in the field during that time, the percentage of improvement is not so great as the advances in surgery would have led one to suppose.

The wounds of the head, of the neck, of the face, of the spinal column, of the trunk and of the extremities are the headings of the five main divisions of the book, and each of these is sub-divided into sections devoted to such topics as may properly form chapter headings.

At the beginning of each chapter statistics are given as to the relative frequency in the various wars of the injuries in-

volved, and also tables of comparison showing the results obtained by treatment. These statistical tables while of little value so far as modern therapy is concerned, add greatly to the value of the book as a volume of reference for military surgeons.

Diagnoses of bony injuries and of the exact location of missiles has been materially aided by the use of radiographs, and a larger number of the illustrations used are derived from this source.

The effects produced by the different types of bullets used, varying from the needle-pointed bullet of the modern French rifle to the irregular and destructive missile caused by bursting shell and shrapnel, have all contributed their share to the collection of wounds depicted, and while it has pleased some writers to refer to the small caliber, high power projectiles used in modern infantry rifles as "merciful," the fact remains that the mortality statistics remain high and do not vary materially from those of the time when soft leaden bullets were habitually used in warfare. Indeed, as has been shown in our own city in the past few months, the penetrating power of the modern weapon is so great that a woman stooping over to pick up some kindlings at a distance of over a mile from a rifle range, was struck by a bullet which passed completely through one thigh, completely through one arm and completely through the head, causing six different openings in the body. In the olden time she would have been out of the danger zone in any event, or if by chance she had been nearer the firing point, such a number of wounds would have been improbable.

Among the many cases cited certain ones of course illustrate well the great variety of wounds which are received in an active campaign and the vagaries of a rifle ball in causing injury. In one case, a bullet striking the right collar bone, entered the supra clavicular fossa and remained within the body. The enormous exudate of blood in the right pleural cavity ultimately resulted in a septic thrombosis which so interfered with circulation in the body that the collateral circulation was ultimately established, gave rise to an extraordinary development of the superficial veins of the legs and of the abdominal walls, showing in the interesting photograph presented as large snake-like vessels over the entire anterior surface of the body below the level of the diaphragm.

A rupture of the thoracic duct as an accompaniment of a wound of the lung, has been observed but once. It is little wonder that such an injury is a rarity, since the aorta lies so close to the duct. The projectile in this particular case, passed obliquely over the spot near the apex of the heart, backward to the right of the spinal column. It is probable that a contused area became necrotic, since the symptoms of injury to the thoracic duct and resulting chylo thorax did not develop for some days. A number of punctures permitted the accumulated chyle to escape.

Cure resulted probably because of collateral circulation permitting the chyle to find its way into the blood stream through a new channel. The torn portion was then probably obliterated.

In the paragraphs devoted to the methods of treatment in the field, of various forms of wounds, it would appear that in recent times the treatment by occlusion of the wound with sterile gauze applied at as early a date as possible, gave the best results save in those cases where the hæmorrhage from a wounded vessel was so great as to demand immediate operative interference. The results obtained in operative cases, particularly in penetrating wounds of the abdomen, unless, as rarely happens in the field, facilities are at hand for operation within six hours of the time of injury, gave but little encouragement to the surgeons, since the mortality rate remains practically as high in such cases as during the Civil War.

HENRY P. DE FORREST.

To CONTRIBUTORS AND SUBSCRIBERS:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 386 Grand Ave., Brooklyn, N. Y.

Remittance for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS OF SURGERY,
227–231 South Sixth Street,
Philadelphia.